FLYING QUALITIES PHASE

PLANNING GUIDE

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USAF TEST PILOT SCHOOL
EDWARDS AIR FORCE BASE, CALIFORNIA

This Flying Qualities Phase Planning Guide has been reviewed and approved. Safety Review Board action was completed on 3 May 94.

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SECTION I
INTRODUCTION

The purpose of this text is to provide an aid to the student for planning flights in the Flying Qualities Phase of the USAFTPS curriculum. In the Performance Phase, your evaluation of an aircraft tended to focus on objective data. Flying qualities flight test is much more than just comparing the results of a flight test to the applicable military standard. In the Flying Qualities (FQ) Phase, you will be greatly expanding your role as a subjective evaluator, as it is the pilot's opinion of how well an airplane flies its intended mission that often determines its fate. In this phase, you learn how to make an overall assessment of an aircraft's flying and handling qualities relative to a specific mission using a very deliberate, build-up approach. At the center is the model validation test method--predict the airplane response, based on a model; test the prediction; and validate or correct the model, based on test results. This method will be introduced and used as a template for testing. The challenges to flight control system design and test posed by aerodynamic, structural, flight control, and handling qualities models will be explored in the flying qualities phase. Finally, to augment your flying qualities test abilities, classical, more first-order techniques for determining military standard compliance will also be taught and practiced during this phase of training.

An accurate understanding of several terms is important. Figure 1.1 and the following definitions should help in understanding the terms and their relationship to each other.

<u>Flying Qualities:</u> The characteristics, or dynamics, of the augmented airplane (or of the bare airframe when there is no augmentation system).

<u>Static Stability:</u> The initial reaction of an aircraft when displaced from an equilibrium condition.

<u>Dynamic Stability:</u> The time history of the response of an aircraft when displaced from an equilibrium condition.

<u>Control:</u> Steering an aircraft on a specified flight path.

<u>Open Loop:</u> A system where the output has no influence on the input. In a flying qualities evaluation, the aircraft is disturbed and then the pilot takes no action to influence the resulting aircraft response.

<u>Closed Loop:</u> A system where the output is compared to the input and the input is modified to achieve an acceptable response. A feedback system is used to compare output to input.

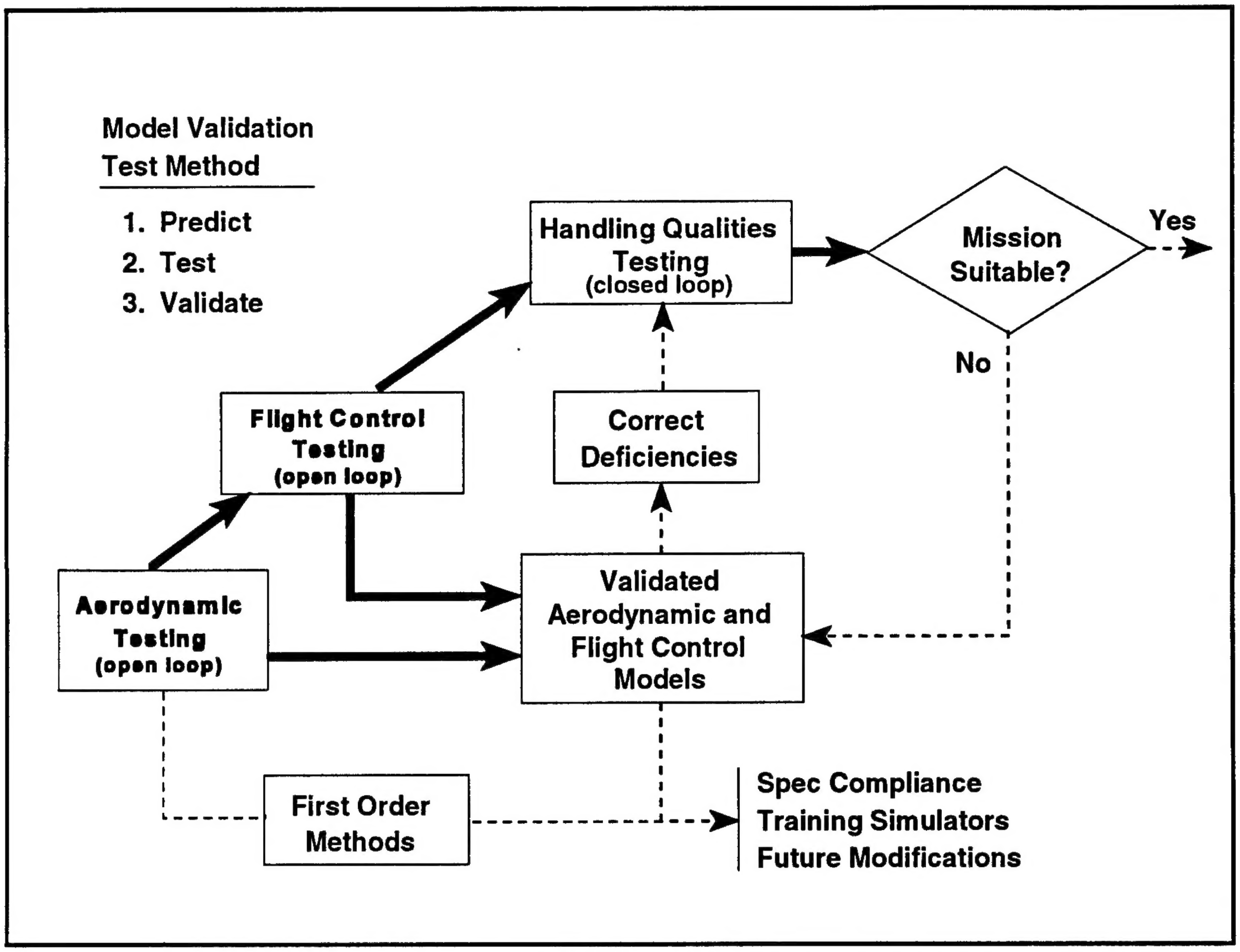

Figure 1.1

Pilot-In-The-Loop: The pilot is the feedback system used to modify the control system inputs to achieve the desired aircraft output.

Handling Qualities: Those qualities or characteristics of an aircraft that govern the ease and precision with which a pilot is able to perform the task required in support of a mission role. Handling qualities are the characteristics, or dynamics, of the closed loop pilot plus airplane.

Handling qualities testing can be accomplished using a build-up approach with three distinct phases:

Phase 1 Handling Qualities Testing: Open-loop and semi-open loop tasks consisting of relatively low pilot gain (or workload) tasks. These maneuvers assist the pilot in exploring and becoming acclimated to the airplane response.

Phase 2 Handling Qualities Testing: High gain tasks using specialized test maneuvers and piloting technique known as Handling Qualities During Tracking (HQDT). Phase 2 testing puts

maximum "stress" on the flight control system and exposes potential handling qualities problems in preparation for the next phase of testing.

Phase 3 Handling Qualities Testing: During this type of testing, pilots evaluate handling qualities while performing typical mission tasks such as air to air, air to ground, air refueling, and takeoffs/landings. Pilot gain during these maneuvers can range from low to high. It is after this phase of testing that a true assessment of the airplane's mission suitability can be made.

The test pilot and engineer need many tools to determine what the various aspects of aircraft behavior mean to accomplishing the mission. Two of the most important tools are knowledge and experience. This phase of the curriculum will provide the fundamentals of both. As in each phase at the Test Pilot School, we will move progressively through theory, application, reporting, and a staff evaluation. The process you will follow through both the Flight Control Project and the flying qualities evaluation of your data group aircraft moves from academic theory to flight test technique to data collection, analysis, and reporting. Figure 1.2 outlines the major flying events in the curriculum.

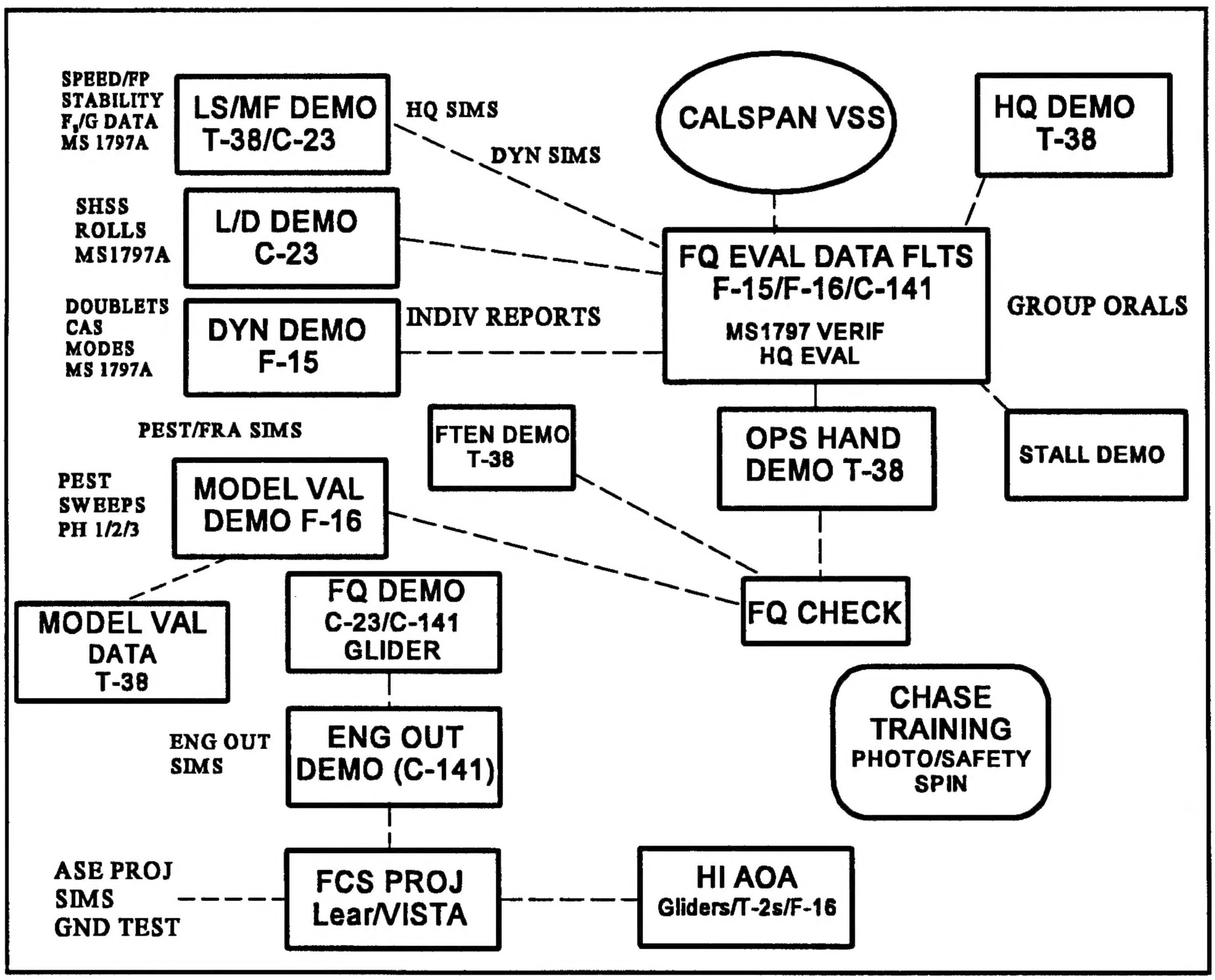

Figure 1.2

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SECTION II
LIMITATIONS

The Flying Qualities test plans for each aircraft contain specific limitations, flight test envelopes, and test points. All test points flown by the student test pilot/engineer will be selected from those listed in the test plans. At no time will the limitations contained in the applicable aircraft Technical Order be violated. In addition, attention must be directed to the minimum and maximum altitudes, airspeed, angles of attack, and other limits set forth in the test plans and AFFTC Forms 5028 and 5028a (Appendix B of this phase planning guide). All of this is not designed to restrict or discourage initiative but to keep the scope of testing to a reasonable level. In the academic environment, edge-of-envelope testing is neither desired nor required. The student test pilot/engineer will learn the concepts, test techniques, and mission application from testing in the heart of the envelope and not near the edge of the envelope. It is realized that all test programs employ a proper buildup program before attempting flights in a critical area. You, as the student test team, must employ and practice these buildup techniques, even though the critical areas will not be explored. Flight testing and buildup programs go together.

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SECTION III
FLYING QUALITIES TRAINING

REFERENCES:

1. Flying Qualities Textbooks
2. MIL-STD-1797A
3. MIL-S-83691B (USAF)
4. F-15, F-16 and C-141 Limited Flying Qualities Test Plans

DISCUSSION:

1. This phase planning guide contains demonstration sorties which will precede the data sorties you will fly for your assigned data group aircraft. Most of the sorties are concerned with collecting data for MIL-STD-1797A compliance; however, pilot comments regarding handling qualities should also be collected when they are appropriate. Other demonstrations use techniques consistent with Phase 2 (HQDT, for example) and Phase 3 (operational handling) maneuvers. In addition to the demo and data sorties, a flight control design project will be accomplished during this phase. Specific requirements will be given in class; however, many techniques learned from your demo/data sorties will apply when evaluating your flight control design.

2. During the Flying Qualities Phase, each student will be assigned to a test group for the purpose of accomplishing a limited flying qualities evaluation on one of the school's aircraft (F-15, F-16 or C-141). The test will be flown in accordance with the applicable test plan and the aircraft will be evaluated against the requirements of MIL-STD-1797A. The results of the evaluation will be presented in a group oral report near the end of the Flying Qualities Phase.

3. Data flights are planned for each group on the basis that each pilot will fly at least one data mission in each of the following areas:

   a. Longitudinal Static Stability and Maneuvering Flight Data.
   b. Lateral-Directional Static Stability Data.
   c. Dynamics Data.
   d. Aerodynamic Model Validation and Frequency Response Analysis Data
   e. Operational Handling.
   f. Stall/High Angle of Attack Data.

Questions on the flying qualities data flights and/or test plans should be directed to the Commander, Flying Qualities Training Flight, Student Training Division.

4. Data flight duration should be no more than 1.5 hours in the F-15 and F-16, and 4.0 hours in the C-141. Data flights will be not be flown by a pilot until he/she has satisfactorily completed the applicable demo mission. The demo missions are explained in the text of this Phase Planning Guide. Grade sheets for these demo rides are found in Appendix A of this Guide. In addition, the Flying Qualities textbook (Chap 22) contains handling qualities pilot comment sheets that may be used as applicable on a given sortie. Once the demo is complete, students should be prepared to fly data missions within 1 or 2 days. Engineers will normally fly in the back seat of two-place airplanes or at the FTE/N station (jumpseat or pallet) of the C-141 during data missions. Primary duties of the FTE/N include mission director and clearing.

5. Each group leader will be responsible for the conduct of the test in his group aircraft. Normally, he or she will assign specific areas to members of the group. Data flights in each area of stability and control will normally be scheduled immediately following the applicable demonstration mission. However, at the discretion of the group leader, data flights may be combined (i.e., part of a dynamics mission may be used to get sideslip data) with the stipulation that a pilot cannot fly a data mission until he has completed the demonstration flight in that area. Trim change data will have to be obtained on other test missions since no missions will be scheduled specifically for this purpose.

6. Data aircraft will be scheduled with the instrumentation, center of gravity requirements (if applicable) and fuel load set up for the mission to be flown. In some cases, it may not be possible to combine data missions since the instrumentation, configuration, or cg requirements for the two missions may not be compatible.

7. All testing will be done in accordance with the approved test plan for the group aircraft. An amendment is required for testing at test points or conditions not covered in the test plan. The test group should endeavor to cover all areas of the test plan with the planned data missions. Keep in mind that a full evaluation at each test condition may not be required to meet test objectives. However, when this is not possible because of conditions beyond the control of the test group, either the scope of testing may be limited with the concurrence of the Commander, Flying Qualities Training Flight, Student Training Division, or additional test sorties will be scheduled. In addition to the other preflight requirements (briefing, etc.), the pilot and FTE/N flying the mission will prepare data cards, have them reviewed and initialed by a TPS instructor pilot current in the group aircraft and leave a copy with the Operations Duty Officer prior to flying the mission.

8. Some helpful hints which may make the limited flying qualities testing run smoother:

a. In planning the tests, the group should look at the requirements of the

MIL-STD-1797A and the instrumentation available and then plan and fly the missions so as to obtain the necessary data. Use the test plan as a guide.

b. Where possible test points have been specified assuming that the handling qualities of an aircraft are primarily a function of Mach number, angle of attack and dynamic pressure. Some sets of test points are at constant dynamic pressure q and others are at constant Mach. This technique provides a matrix for investigating the effect of Mach and q.

c. Check the instrumentation setup and cg location for each data mission as a part of the aircraft preflight. In the past, aircraft have not always been configured as scheduled. Any problems with this should be brought to the attention of your data group leader and operations scheduler.

d. Use the staff monitor(s) assigned to your data group. They may be helpful in checking data cards, test results and as a sounding board during group meetings.

9. Read and reduce mission data as soon as possible after the mission is flown. As a guide, no more than two missions on an aircraft should be flown prior to reducing the data. The benefits of early data reduction are twofold: the details of the flight are less likely to be forgotten; and if the instrumentation has malfunctioned, the problem will hopefully be detected and fixed before other data missions are flown in that aircraft. If a test mission is incomplete, the pilot who flew the missions should report this fact to the Operations Scheduler so that the mission can be rescheduled. In addition, instrumentation malfunctions should be written up in the aircraft forms and reported to the Technical Support Division so that the malfunctions get fixed.

10. A briefing on requirements for the flying qualities final oral report will be given during academics. All data groups should plan to include the results of testing for longitudinal static stability, maneuvering flight stability, lateral-directional stability, dynamic stability, operational handling, trim changes, stall/high angle of attack characteristics, and engine out (C-141 only) as a part of their flying qualities final oral report. The bottom line wil be mission suitability of your data aircraft.

11. FTT practice missions in addition to those formally required may be scheduled when aircraft availability permits. The profiles for these missions are found in this Phase Planning Guide. A qualified instructor pilot in the aircraft to be flown will approve and initial the data cards. You may practice any FTT in which you have previously received formal instruction. Touch and go landings may be performed on FTT or data missions if fuel permits.

12. The overall and most important objective of the Flying Qualities Phase is to determine the suitability of your test aircraft for a specific mission. By combining the results of both MIL-STD compliance and handling qualities evaluations, you should be able to make a justifiable

assessment in this regard. It is imperative you keep this objective in mind throughout your entire flight test career.

13. Tolerances for all Flying Qualities events are provided below:

EVENT	DATA BAND AND TOLERANCES
TRIM SHOT	±3 KIAS, ±200 FT OF AIM THEN STABLE FOR 10 SECONDS HANDS OFF (±2 KIAS, ±100 FEET)
LONGITUDINAL STATIC STABILITY ACCEL/DECEL STABILIZED	 ±1000 FEET, NO STICK FORCE REVERSALS ±2000 FEET, ±2 KIAS
MANEUVERING FLIGHT STABILIZED SLOWLY VARYING SYMMETRIC PULLUP	±2000 FEET, ±2 KIAS, ±.2G, ±2000 FEET, ±2 KIAS .2G/SEC ONSET RATE MAX ±1000 FEET, ±5 KIAS, ±.2G ±10 DEGREES OF LEVEL FLIGHT
THRUST EFFECTS ACCEL/DECEL	±1000 FEET, NO STICK FORCE REVERSALS EXCEPT THROUGH ZERO FORCE
AILERON ROLL	±1000 FEET, ±2 KIAS
STEADY STRAIGHT SIDESLIPS STABILIZED SLOWLY VARYING	±1000 FEET, ±2 KIAS

DYNAMICS SHORT PERIOD	±1000 FEET, ±2 KIAS
DUTCH ROLL	±1000 FEET, ±2 KIAS
PHUGOID	±200 FEET, ±2 KIAS BEFORE SLOW DOWN
SPIRAL	±1000 FEET, ±2 KIAS AT START
FLIGHT PATH STABILITY	±1000 FEET ±2 KIAS OF AIM (V_{OMIN}, +5, -5, -10) STABLE V AND VVI
HANDLING QUALITIES MANEUVERS (Phase 1, 2)	As required, generally within ±1000 FEET, ±10 KIAS. May be more restrictive if also doing model validation

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HANDLING QUALITIES DEMO (PILOT)

REFERENCE:
1. Flying Qualities Textbook, Chap 21, 22 and 23

PURPOSE:
1. To demonstrate the HQ flight test techniques (Phase 1, 2, and 3) to collect pilot comments regarding handling qualities.

2. To demonstrate the use of pilot rating scales.

3. To allow the student to understand how to determine suitability of an aircraft's flying qualities for its mission.

4. To practice coordination of target for later flying qualities model validation testing.

AIRCRAFT:
T-38 with gunsight (desired) and suitable target aircraft (required)

LIMITATIONS:
1. Aircraft will not come closer than 1,000 feet to one another during tracking tasks.

2. Additional limitations as listed in the T-38 Flight Manual.

GENERAL:
1. The handling qualities simulators should be complete prior to this sortie. This sortie will normally be flown by the pilots only, though FTENs are encouraged to participate in the target aircraft.

2. The student should be prepared to use the Phase 1, 2, and 3 HQ test techniques to give qualitative comments regarding the aircraft's handling qualities. These techniques are the foundation of all flying qualities testing, but take practice to be completed correctly and efficiently. This sortie will be the first of many to build your experience base for evaluating aircraft handling qualities. The T-38 will be evaluated as a lead-in fighter trainer.

3. Other sorties for model validation testing may require an instrumented aircraft and/or telemetry--note that for handling qualities testing, the pilot comments and ratings are the critical data. The pilot is the handling qualities "sensor."

MISSION EVENTS:

1. Mission Preparation.

Review the techniques for handling qualities testing as discussed in classroom and practiced in the simulator. Make data cards to record qualitative comments and ratings. Bring a Cooper Harper and PIO rating scale for use in flight.

2. Briefing.

The IP will conduct the briefing and coordinate use of target aircraft. Review methods of Phase 1, 2, and 3 testing and use of rating scales. Discuss formation references and advanced rejoins as appropriate.

3. Preflight/Ground Operations.

During the flight control check, pay particular attention to the control forces and deflections you experience as you move the stick and rudder pedals. The test techniques to quantify these will be addressed in later demonstrations, but their characteristics will influence your handling qualities data.

4. Takeoff.

The target will perform an interval or airborne pickup with the test aircraft. The target should plan to remain in a chase position until needed by the test aircraft.

5. Climbout to 15,000 ft/400 KIAS.

During climbout, the IP will demonstrate and the pilot should perform some low bandwidth, Phase 1 maneuvers (size of inputs consistent with a buildup approach). These include step inputs in pitch, yaw and roll; doublets in all three axes; bank angle/heading captures; and steady heading sideslips. Perform enough Phase 1 to be able to comment on aircraft response in all three axes.

NOTE: These maneuvers will be covered in much more depth during later demonstrations. Note that for handling qualities purposes they need not be accomplished with the same precision required for other types of data (such as MIL STD 1797A or stability derivative estimation) but serve as a way for the pilot to "warm up" to an unfamiliar aircraft's handling qualities. These types of Phase 1 maneuvers are open loop and semi-closed loop in nature, and will affect the

closed loop handling qualities of the pilot plus aircraft combination. Once complete with Phase 1 maneuvers, the target will assume the lead for the next phase of tests.

6. Phase 1, 2, and 3 Air to Air Tracking (15,000 ft/400 KIAS).
The test aircraft will maneuver to a position approximately 1,500 ft behind the target aircraft. Suggest using a 50 mil depression in the gunsight (if available), otherwise ensure your tracking pipper is drawn about the tip of the pitot boom. This will keep you out of the target aircraft's wake during tracking.

a. Phase 1 and 2 tracking (3g and 4g turn)--IP Demo/Student Practice.
Target: When on conditions (±1,000 ft, ±10 kts) call "Target ready." Strive to maintain these conditions throughout all maneuvers. Initially start a 3 g turn--the test aircraft will call when to increase to 4 g and reverse (prefer loaded reversals). Maintain area orientation for the flight.
Test aircraft: Once target has called ready and you are ready, call "Cleared to maneuver, left/right turn." Begin tracking the target as soon as it starts maneuvering. You may again find it useful to spend a few seconds "warming up" in bandwidth, keeping the target merely in the field of view of your pipper rather than tracking to zero error (Phase 2) right away. Any comments on the aircraft's handling should be noted.
NOTE: The IP will assist you in maintaining proper spacing (1,000-1,500 ft desired) from the target. As a guide, if the target's wingspan is about that of a T-38 (~25 ft), its wingspan will be circumscribed by a 25 mil circle at 1,000 ft. You will also be able to clearly distinguish the target's burner cans. When ready for Phase 2 (HQDT), proceed to track a point on the target to maintain zero error. Do not use trim. HQDT involves a conscious effort to track as aggressively and assiduously as possible. The point is to get to a high bandwidth (high pilot "gain") in order to reveal the handling qualities of the aircraft under these conditions. After about 15 to 30 seconds of Phase 2 tracking, you should have enough data to make some pilot comments regarding response and potential pilot-in-the-loop oscillations (PIO). When ready, call for the target to increase to 4 g (this may require another set up). Reversals may also be accomplished. At 4 g, pay particular attention to the increase in pitch stick forces and how it affects your aircraft response and PIO susceptibility.

b. Phase 2 tracking (windup turn)--Student Practice.
This maneuver will expose handling qualities over a wide range of g/angle of attack.
Target: On test aircraft's call, initiate a windup turn (increasing g while maintaining airspeed ±10 kts). Set up at the top of the 17,000-13,000 ft altitude block. Increase g at approximately 0.2 g/sec until moderate buffet, 6 g, or bottom of block, whichever comes first.

Test aircraft: When in position approximately 1,000-1,500 ft behind target, call "clear to maneuver." Immediately begin Phase 2 (HQDT), maintaining a range no closer than 1,000 ft. Pay particular attention to the onset of the pitch stick forces and any coupling to the lateral axis. Again, no trim during the maneuver. Make comments regarding aircraft response and PIO susceptibility. Use the PIO rating scale to give a quantitative rating.

c. Phase 3 tracking (pitchouts and/or advanced rejoins)--IP Demo As Required. These maneuvers will allow the pilot to evaluate the aircraft's handling during a more operational type engagement (see Section V, Chase Procedures and Techniques, for a more in-depth description of advanced rejoins). Pitchouts should be initiated from route formation, using 5 second spacing. The set up for advanced rejoins is approximately 4,000-6,000 ft line abreast, 15,000 ft/400 KIAS (IP may demonstrate first). On test aircraft's call, the target will begin the appropriate maneuver. The pilot should try to complete the gross acquisition maneuver as expeditiously and efficiently as possible. After the rejoin is complete, the pilot will comment on the total maneuver, realizing that the aircraft will be in a much less controlled environment than during the previous Phase 1 and 2 tests. Use the Cooper-Harper/PIO rating scale to give a quantitative rating based on the following criteria:

PERFORMANCE LEVEL	GROSS ACQUISITION
Desired performance:	Within 360° target circle Tailpipe within 25 mil 1 overshoot max
Adequate performance:	Within 720° target circle Tailpipe within 50 mil 1 overshoot max

Move on to the next maneuver with at least 2,000 lbs fuel remaining.

7. Phase 1, 2, and 3 Close Formation Tracking (10,000 ft/350 KIAS)--IP Demo, Student Practice. The test aircraft should continue the last Phase 3 rejoin, last test point, above to close formation (approximately 5 feet wingtip clearance, ensure nose/tail clearance for Phase 1 and 2 maneuvers).

Target: Maintain a stable platform as lead. On the test aircraft's call (Phase 3), begin Lazy 8 type maneuvers (±2000 ft, ±50 kt, up to 4 g).

Test aircraft: Close formation is a very intensive task and is an excellent method to reveal

handling qualities characteristics, including stick dynamics and power effects. See Talon Guide for close formation references.

a. Phase 1 and 2.

All Phase 1 and 2 maneuvers will be done with target at wings level, 1 g (time/fuel constraints). As in the air-to-air task, start with low bandwidth (Phase 1) maneuvering, getting accustomed to the environment. During Phase 2, attempt to keep a precise position with no error. For example, aggressively and assiduously track the target's "wingtip in the star." To generate even higher pilot bandwidth, start with the target's wingtip at the top of the star and try to aggressively move it to the center of the star. Maintain nose-tail clearance during Phase 2 maneuvers. Note the aircraft response and any PIO susceptibility.

b. Phase 3.

When ready for Phase 3, tell the target "cleared to maneuver."
Now attempt to maintain the close formation position using the following criteria (assume a 1 minute time period):

PERFORMANCE LEVEL	FINE TRACKING
Desired performance:	Wingtip in star 50% of time
Adequate performance:	Wingtip in insignia 50% of time

When complete, give qualitative comments as well as a quantitative rating using the Cooper-Harper and PIO scales.

8. Phase 1, 2, and 3 Close Formation (PA, Final turn A/S)--Student Practice.

Repeat close formation investigation in landing configuration (60% flaps) to see effects of configuration and airspeed on handling qualities. Use above criteria for Phase 3 investigation.

Target: Limited to 45 degrees bank, a slight descent OK to maintain airspeed in the altitude block.

9. Phase 1 and 2 Air to Ground Tracking--IP Demo As Required.

Target should move to safety chase position. This will demonstrate Phase 1 and 2 techniques

when airborne target is not available (fuel permitting). Use 30 degree dive with base leg at 17,000 ft/300 KIAS; release at 8,000 ft MSL/450 KIAS; minimum altitude 3,000 ft AGL. During Phase 2, aggressively track a ground target (such as a water tank or road intersection) and note handling qualities across this wide q bar band (do not trim or use rudder).

NOTE: Phase 3 techniques for air to ground will be introduced on the Operational Handling Sortie.

10. Landing (Formation Approach--Target permitting).

If target is still available, perform a formation approach to full-stop landing (see Talon Guide for formation approach techniques). The formation approach (a Phase 3 maneuver) may bring out many of the handling characteristics noted during the up-and-away investigation. Pay particular attention to the aircraft's handling versus your workload during the flare and touchdown. If a target is unavailable, perform a normal landing to a full stop or touch and go.

11. Debrief. The pilot will debrief and discuss the handling qualities observed and relate them to the mission suitability of the aircraft for the fighter trainer role. The most critical event in any handling qualities investigation is the debrief. It is extremely important for the pilot to debrief as soon as possible after the flight while the impressions are fresh. A good flight test engineer can also help in extracting from the pilot valuable information and validating the assigned handling qualities ratings.

To evaluate mission suitability, every handling qualities characteristic observed must be put into proper context by knowing the mission role of the aircraft. This requires both judgement and experience in the mission.

INSTRUMENTATION:

None.

DATA REDUCTION/REQUIRED PLOTS:

None.

LONGITUDINAL STATIC STABILITY & MANEUVERING FLIGHT DEMO (PILOT)

REFERENCES:

1. Flying Qualities Textbook, Chapter 6: Introducing the Flying Qualities Military Standard and Chapter 8: Trim and Stability
2. MIL-STD-1797A
3. Talon Guide

PURPOSE:

1. To demonstrate the flight test techniques used to obtain longitudinal static stability (F_s/V) data for MIL-STD-1797A compliance. Two techniques will be examined.
   a. Acceleration/Deceleration
   b. Stabilized

2. To demonstrate the flight test technique used to obtain flight path stability (γ_{PA}/V) data.

3. To demonstrate the effects of friction/breakout on handling qualities.

4. To demonstrate the flight test techniques used to obtain F_s/n, δ_s/n, δ_e/n data to determine MIL-STD-1797A compliance.

AIRCRAFT:

T-38

LIMITATIONS:

As listed in the Flight Manual, in particular unsymmetric G limits (4.3G with 3000 pounds fuel, 4.7G with 2000 pounds fuel, and 5.1 with 1000 pounds fuel).

MISSION EVENTS:

1. Mission Preparation.

Pilot: Responsible, within the constraints of the mission card, for flying an efficient mission profile with special emphasis on moving efficiently from point to point on the card. Prepare a data card for the mission. This card will cover the necessary in-flight data. Present a copy of this card to the IP. Plan to record data using a standard T-38 DAS (simulated if not available).

2. Brief.

IP: Brief the entire mission with emphasis on attitude flying, unusual attitudes, recoveries and

symmetric/unsymmetric G limitations.

3. Ground Block.

Pilot: Perform a stability and control ground block. This will be accomplished in the following manner:

a. Turn data on.

b. Move the controls according to the "EAR" check.

(1) E - Elevator full aft then full forward.

(2) A - Ailerons full right then full left.

(3) R - Rudder full right then full left.

The purpose of this is to insure that the traces are moving in the proper direction and at the proper amount. Also, with proper instrumentation and an irreversible flight control system, friction and breakout as well as stick force/stick deflection gradients can be obtained. With such data, compliance with applicable MIL-STD-1797A paragraphs can be evaluated. Paragraphs include 4.2.8.4 Pitch Axis Control Force vs Control Deflection; 4.2.8.5 Pitch Axis Control Breakout Forces; 4.5.8.4 Roll Axis Control Centering & Breakout Forces; and 4.6.7.11 Yaw Axis Breakout Forces. Move the controls slowly and event the neutral points. Estimate the maximum control forces and deflections. Also, perform a limited performance ground block.

4. Takeoff. Perform a Mil thrust takeoff in order to give the pilot more time to evaluate the T-38 flying qualities. Qualitatively note F_s and δ_s from rotation through flap retraction.

NOTE

Use T-38A-1CL-1 Takeoff Factor Graph (not tabulated data) to obtain the Takeoff Factor for Mil Power. If the military thrust takeoff factor is greater than 4.90, a maximum thrust takeoff will be performed.

5. Trim Shot (20,000 ft MSL, 220 KIAS, CR).

Pilot: Set 29.92, Standby mode in the altimeter and obtain a trim shot, gear up, flaps up, 220 KIAS, 20,000 ft. Simulate proper instrumentation switches to include the event button. Turn DAS on and measure the friction/ breakout band by slowly moving the controls until a slight aircraft motion is detected.

6. Stabilized Method, IP Demo.

a. Background: This FTT, as well as the Accel/Decel Method which follows, is designed to verify compliance with MIL-STD-1797A para 4.4.1, Speed Response to Attitude Changes. This paragraph requires that there "be no tendency for airspeed to diverge aperiodically when

the aircraft is disturbed from trim." To clarify what this really means to a pilot evaluating the static stability, it says that "static stability means that restoring pitching moments are generated when airspeed is disturbed from trim." This classical definition of static stability will then be satisfied "if the gradients of pitch control force with speed are negative." i.e. F_s/V negative; increasing stick force with decreasing speed, and vice versa. This guidance, thus, is generally qualitative. However, this FTT allow the gradient to be quantified. The MIL-STD does not quantify what the gradient must be - simply it should be negative. It goes on to specify that the lower boundary for the stick force gradient is neutral stability, recognizing that newer, higher order flight control systems provide precisely that. An additional note on 1797A requirements - for static stability test points, the MIL-STD (by referring to previous source document MIL-F-8785C) requires a data band of ± 50 knots equivalent airspeed. For the purposes of this demonstration, we fly ± 50 knots indicated airspeed for ease of reference. (Actually, this introduces little error: 350 KIAS ± 50 KEAS = 292 - 405 KIAS, vs the 300 - 400 KIAS we currently demo).

b. IP: Demonstrate stabilized test method at 250, 235, 205 and 190 KIAS (MIL-STD-1797A specified data band is the smaller of ±50 KIAS or 15% from trim airspeed) with trim thrust set. The stabilized data method works best when aircraft trim speed is at or below the maximum glide speed (drag bucket). It will work at higher airspeeds, however the faster speeds will cause problems staying in the data band. For the T-38, the maximum glide speed is 230 + 1 knot/100 pounds fuel. (For this demo, the drag bucket is approximately 260). On the first point, it is usually better to go to a region of positive P_s; therefore lower the nose to increase the airspeed from 220 KIAS to 250 KIAS. Once the airspeed reaches 250 KIAS, raise the nose sufficiently to hold the airspeed (approximately the same pitch attitude as for 220 KIAS trim shot) and stabilize at 250 KIAS. At this point you may be anywhere in the friction band. The friction has a minimum and maximum force which differ by the magnitude of the friction band (approximately three pounds). Stabilized data is best taken at the maximum force side of the friction band. Slowly push forward on the stick until you detect nose down movement. The last control motion must be a push and last nose movement must be nose down to insure you are on the maximum force side of the friction band. "Event" and call out the estimated force. The DAS should normally run continuously using a remote event button for DAS data systems. Note that due to positive P_s at this speed with trim thrust set, the aircraft will be in a stabilized 600-700 fpm climb. Next, slow to 235 by increasing pitch attitude and reestablish approximately the same pitch attitude as for trim speed. The slow points are done next by using altitude and/or drag devices (speed brakes) to establish the airspeed at 205 KIAS and 190 KIAS. After the pitch attitude is established to stabilize on the target airspeed, (again, approximately the same attitude as trim shot) increase the pull force until you detect the first nose up movement. The

last force must be a pull and the last nose movement must be up to insure you are on the maximum force side of the friction band. To obtain valid data the stick must be consistently on the same side of the friction band and absolutely frozen at the time of eventing with the airspeed and pitch steady. When using the stabilized method for points below the drag bucket speed, the pitch attitude is approximately the same as the trim shot pitch attitude. This happens because the climb/dive angle changes (which comes from the net P_s) tend to cancel the angle of attack changes above and below trim speed.

7. Stabilized Method, Student Practice.

Pilot: Accomplish stabilized points 250, 235, 205 and 190 KIAS with same trim and thrust setting. Resetting the throttles invalidates the data, so thrust should not be changed until the test is completed. Data band is ±2,000 ft.

8. Student Trim Shot (20,000 ft MSL, 350 KIAS, CR).

Pilot performs a trim shot at 20,000 ft MSL, 350 KIAS, cruise configuration.

9. Acceleration/Deceleration Method, IP Demo.

IP: Demonstrate the level acceleration/deceleration method. The level accel/decel method works best when aircraft trim speed is above the maximum glide speed (drag bucket). This method will not work when trim speed is below the maximum glide speed, since net thrust will cause the airspeed to diverge from trim speed when trim thrust is reset. The level accel/decel method provides data on the minimum force side of the friction band. The maneuver will be performed in level, or near level flight at trim airspeed (350 KIAS for this mission) ±50 KIAS (or 15%), as specified in MIL-STD-1797A. Note stable-point RPM setting, then decelerate by reducing thrust and/or using drag devices without changing the flight control stick trim. At approximately 280 KIAS and 20,000 ft MSL, turn on the DAS and reset trim RPM (±2% for aircraft with negligible thrust effects). Note any changes in pitch forces due to addition of thrust. Though there is no specific requirement in MIL-STD-1797A, pilots should comment on thrust effects and their impact on handling qualities. A pull force will be required to maintain pitch and altitude. As the aircraft accelerates, you must reduce stick pull force to allow the pitch attitude to decrease in order to maintain a constant altitude. The "feel spring" is now pulling the stick towards trim; therefore, you are on the minimum side of the friction band. You are controlling the rate that the spring returns the stick to the trim band. If too much back pressure is released and the pitch attitude drops so much that altitude begins to decrease, just freeze the stick and allow the increasing airspeed to raise the nose. Make a pilot comment so you'll know the point is off. Do not increase the pull force to raise the nose, since this would place you inside the friction band toward the maximum force side and therefore make your data inconsistent.

After the aircraft stabilizes in the free-return airspeed zone (approximately 10-15 knots either side of trim speed), turn off the DAS and increase thrust to accelerate to 420 KIAS without changing the flight control stick trim. Once reaching 420 KIAS and 20,000 ft MSL, turn on the DAS and reset the trim thrust. Again note any differences in pitch forces. At this point, a push force is required to maintain pitch and altitude. As the aircraft decelerates, you must reduce stick push force to allow the pitch attitude to increase in order to maintain a constant altitude. Again, the "feel spring" is pulling the stick back toward the trim band. If too much push force is released and the pitch attitude increases causing an increase in altitude, just freeze the stick and allow the decreasing airspeed to drop the nose. Do not increase the push force to lower the nose since this would place you inside the friction band and would not represent consistent, minimum force side data. When the airspeed stabilizes in the free-return airspeed zone (forces less than friction/breakout) turn off the DAS.

Very light stick forces (normally less than 10 pounds maximum) will be encountered. This fact, combined with a friction band of about three pounds, dictates that the maneuver be performed smoothly with consistent stick force application and pitch direction so that data are recorded on the minimum force side of the friction band. The key to insuring that you don't change sides of the friction breakout band is to not change the direction of stick movement. It may be stopped momentarily, but never reversed throughout the period of collecting data.

Though not part of this demonstration, a max thrust accel/mil decel using similar techniques as this demonstration may be used to determine compliance with MIL-STD-1797A (4.4.1.1), Speed Response to Attitude Changes -- Relaxation in Transonic Flight. MIL-STD-1797A allows for the speed stability previously investigated to be somewhat unstable in the transonic region. It specifies that the force change in the transonic region not exceed 10 lbs. Furthermore, it specifies that no local force gradient within that region be more unstable than 3 lbs. per 0.01 Mach number.

10. Acceleration/Deceleration Method, Student Practice.
Pilot: Practice level accelerations/decelerations from 350 KIAS.

11. Trim Shot (24,000 ft MSL, 325 KIAS, CR.)
Pilot: Obtain a trim shot at specified conditions.

a. Data band: ±200 ft, ±3 kt of target altitude and airspeed.
b. Time: Goal is 3 minutes to achieve a 10 sec stable point (±100 ft, ±2 kt).

Background: Following are three basic types of maneuvers designed to extract maneuvering flight data - the wind-up turn (either stabilized or slowly varying), the pullup/pushover, and the

sinusoidal stick pump. All of these maneuvers are flown for a single, specific purpose - to determine if the Fs/g gradient is in compliance with Mil-Std 1797A para. 4.2.8.1. Although qualitative data can be obtained regarding stick forces and linearity, the intent is to quantify the gradient. Table XVII in the Mil-Std establishes the upper and lower limits of the Fs/g gradient. The maximum gradient is a function of the normal-acceleration-to-AOA ratio, n/α, and is thus the primary reason for conducting the sinusoidal stick pump - i.e. to determine n/α, which is then used to determine the upper limit of Fs/g. It is worth noting also that 1797A specifies requirements only for center stick and wheel controller aircraft, acknowledging a complete absence of gradient requirement for side stick controller aircraft.

12. <u>Stabilized G Method (22,000 ft MSL, 325 KIAS, CR), IP Demo.</u>

a. IP: Demonstrate the maneuvering flight stabilized G method. The test point parameters are 325 KIAS, 22,000 ft, with a ±2,000 ft data band. Consequently, the maneuver should begin near 24,000 ft (may have to start 200 ft low to ensure aircraft stays within data band the entire time). Note trim power. Begin constant airspeed maneuver. Stabilize at $\phi = 15°, 30°, 45°$ and $60°$. Thereafter, stabilize at discrete G levels (increasing approximately 0.5 G per level) until passing 20,000 ft or reaching heavy buffet. Attempt to hold the stick on the back side of the friction band at each point. Verify the aircraft does not go out of the data band. Freeze the stick when recording data. Attitude flying should be stressed during the maneuver with a cross-check of airspeed. Remember there will be slightly less than 2.0Gs at 60° bank due to the descent and bank angle changes past 60° should be very gradual to keep the airspeed under control. If buffet is not reached by the time the bottom of the altitude band is passed, climb back to 24,000 ft efficiently (i.e. 300-350 KIAS), reset trim power and continue with next G increment.

b. Data band: ±2 kt, ±2,000 ft from test point altitude.

CAUTION

OBSERVE UNSYMMETRIC G LIMITATIONS WHEN THERE IS A ROLL RATE ON THE AIRCRAFT, AS WHEN RECOVERING FROM MANEUVERING FLIGHT TEST POINTS.

13. <u>Stabilized G Method, Student Practice.</u>

Pilot: Perform stabilized G method in cruise configuration at 325 KIAS.

14. <u>Slowly Varying G Method (22,000 ft MSL, 325 KIAS, CR), IP Demo (OPTIONAL).</u>

IP: Demonstrate slowly varying G method in cruise configuration for 325 KIAS, 22,000 ±2,000 ft MSL. Altitude band, trim setting and airspeed criteria remain the same as for the stabilized G method. Light stick forces in the T-38, up to 60° bank, create a tendency for reversing stick

forces. This is especially true at 20° bank where the aircraft nose may rise slightly. This can be counteracted by beginning the maneuver with the nose slightly low. It is better to allow the airspeed to increase or decrease (±2 kts) than to allow a stick reversal. Attempt to keep load factor increasing at no more than 0.2G/sec to minimize dynamic effects. This rate is particularly critical past 60°. Again attitude flying should be stressed.

NOTE

During the slowly varying G maneuver, symmetric G limitations apply. However, unsymmetric G limits can easily be exceeded while recovering from either the slowly varying or stabilized maneuver.

15. Slowly Varying G Method, Student Practice.
Pilot: Perform slowly varying G maneuver in cruise configuration with the same data band and configuration.

16. Pullup/Pushover, (22,000 ft MSL, 325 KIAS), Student Practice

a. Pilot: Perform pullup maneuver in cruise configuration at 22,000, 325 KIAS. Obtain a trim shot at 22,000 ft MSL/325 KIAS. Leave thrust set and pullup to exchange airspeed for altitude. Use a shallow 10-15 degree climb until 1500-2000 feet above test altitude. You will lose 50-75 knots during the climb. Then push over to begin a 20 degree dive. At an appropriate lead point, as you approach your target airspeed, initiate a smooth pull to target load factor. As the nose passes through the horizon (± 10 degrees), read/event stick force and actual G. Perform 2G and 3G pullup to get data at 22,000 ft MSL/325 kts. A 4G pullup may also be performed if time and proficiency permit. Dive angle and airspeed lead depend on aim load factor. Use approximately 20° dive and 15 kts (slow) airspeed lead for 2G. Less lead in airspeed is required with higher target load factors. Use a 10 knot lead for 3G points, and 0 knot lead for the 4G point. This FTT may also be flown by varying dive angle, using progressively steeper dives for higher load factors. Maneuvers may be practiced one after another. Thrust may have to be added to gain energy and then reset to trim thrust to stay in altitude band after several maneuvers. Stick force and load factor must be constant when collecting data. Varying stick force and load factor just before reaching horizon in an attempt to achieve aim load factor invalidates the data. If stick force is never relaxed during pull, the stick will be on the back side of the friction band.

b. Perform a pushover maneuver in cruise configuration at 22,000 feet, 325 KIAS. After re-establishing at previous trim conditions, begin a shallow 5-10 degree descent to accelerate 20-40 KIAS. Then initiate a 10 degree climb back toward target altitude. As airspeed decreases, use a 5 knot lead above target airspeed to smoothly push over to 0G. Note F_s and G.

c. Data band: ±5 kt, ±1,000 ft, within ±10° of level flight.

17. Sinusoidal Stick Pump, IP Demo.

a. The sinusoidal stick pump test technique can be used to evaluate the following handling qualities:

(1) Transient Control Forces.

(2) Control System Dynamics.

(3) N/α Determination. Dynamic normal acceleration change (Δn) per unit change in angle of attack (Δα).

b. Control system dynamics and transient control forces are not evaluated in this sortie. Dynamic n/α can be determined by continuously recording load factor and angle-of-attack while pumping the elevator sinusoidally. These inputs should be kept small to ensure that the linear region of n/α is achieved. Steady state n/α can also be determined by noting load factor and angle-of-attack during steady turns, pullups and varying G maneuvers. However, this technique may result in a value of n/α which varies as a function of α due to non-linearities in the lift curve slope.

c. The initial stick input should be small and at a low frequency. The input can then be increased in magnitude and frequency until a satisfactory aircraft response is achieved. Load factors changes should not exceed ±0.5G from 1G.

18. Sinusoidal Stick Pump, Student Practice.

CAUTION

IT IS POSSIBLE TO DEVELOP A PILOT INDUCED OSCILLATION (PIO) AT HIGH MACH NUMBERS AND LOW ALTITUDES WHILE PUMPING THE CONTROL STICK SINUSOIDALLY. EXTREME CARE SHOULD BE USED AT ALL TEST POINTS AND ESPECIALLY THOSE AT HIGH Q.

19. Flight Path Stability, IP Demo.

a. Background: This FTT is flown to investigate compliance with MIL-STD-1797A para 4.3.1.2, Steady-state Flight Path Response to Attitude Changes. It is a measure of how steep the flight path angle becomes as speed drops below normal final approach speed.

b. IP: Demonstrate flight path stability method. Flight path stability is an aircraft performance requirement at the recommended final approach speed (V_{omin}). Stick force and elevator position are not needed, so only hand recording of airspeed, altitude, temperature, and rate of descent is required. In the power approach configuration (gear down, flaps 100%), establish a 800 to 1,000 ft/min rate of descent at V_{omin} at approximately 12,000 ft MSL (data

band 11,000 to 9,000 ft MSL). This gives a glidepath of approximately 3° which is the steepest precision glidepath that can be expected. This is done by a modified back side trim shot. Maintain the airspeed with the stick and establish the rate of descent (R/D) with the throttle. When established at V_{omin} with rate of descent stable in the band from 800 to 1,000 ft/min, record V_i, rate of descent, temperature, and altitude. Then with the stick alone, increase the airspeed approximately five knots, stabilize, and record the same four parameters. It is best to fly the V_{omin} +5 knot point immediately after the V_{omin} point to ensure adequate separation of the 2 points when plotting TAS as the MIL-STD requires. If the airspeed varies as much as one knot, it will destabilize the R/D. The altitude is recorded at each test point to allow a correction factor to be applied to the R/D. The correction factor compensates for the thrust change with changes in ambient conditions. The correction factor is obtained by repeating V_{omin} as the last data point to see the change in R/D at the lowest altitude in the band. The final V_{omin} point must be obtained in the data band (11,000 to 9,000 ft MSL), so the test points should be obtained rapidly.

20. Flight Path Stability, Student Practice.
Pilot: Perform flight path stability tests at V_{omin}, +5, -5, -10, and V_{omin}. After thrust is set for the initial V_{omin}, the remaining points must be completed within the data band with no thrust changes. V_{omin} should now be lower than that demonstrated due to fuel depletion. The R/D at the test points may vary from day to day due to atmospheric changes with altitude. If turbulence or excessive wind shear are experienced, the data is obviously invalidated, so use some judgment on when to curtail the test and go on to the remainder of the mission.

21. Trim Shot (9,500 ft MSL, 175 KIAS, Gear, Flaps 60%, (OPTIONAL FUEL PERMITTING).
Pilot: Perform trim shot at 9,500 ft MSL and 175 KIAS, Gear down, Flaps 60%, thrust for level flight.

22. Stabilized G Method, Student Practice (OPTIONAL FUEL PERMITTING).
Pilot: Perform stabilized G method at 175 KIAS with gear down, flaps 60% from 9,500 ft to 7,500 ft MSL. Recover at moderate buffet or 60° bank, whichever occurs first.

23. Pitch Trim Changes/Landing.

a. Background: This FTT is flown to verify compliance with MIL-STD-1797A para 4.2.5, Pitch Trim Changes, Table XV, lines 2 & 4. Since the various combinations of configuration changes (i.e. gear, flaps, speed brakes, etc) and parameters to be held constant during the configuration change (e.g. altitude, speed, attitude, etc) can create an extensive matrix of points to evaluate, we have specified two points to evaluate - gear down, then flaps down, while holding altitude constant. The MIL-STD specifies the maximum force (10 pounds) that can be

experienced during a specific time interval (5 seconds) after the pilot action which initiated the configuration change.

b. Pilot: Perform a normal landing from a straight-in approach. Trim the aircraft at 3,300 feet MSL and 230 KIAS no later than the TACAN. Then, without retrimming, extend the gear while maintaining altitude constant. Estimate the longitudinal stick force required during the 5-second period after placing the gear handle down. Then, stabilize at 210 KIAS and re-trim. Extend the flaps and estimate the pitch trim change in the same manner. Qualitatively note longitudinal stick force and deflection required during final approach, flare, and landing roll out. The aircraft should be trimmed at final approach airspeed to evaluate the flare stick force.

24. Ground Block.
Pilot: Perform a post-flight stability and control ground block.

25. Debrief.

a. Pilot: Debrief the IP on quality of data.

b. IP: Debrief on mission planning, FTT performance and quality of data.

INSTRUMENTATION:
None required. All data gathering will be simulated.

DATA REDUCTION/REQUIRED PLOTS:
None.

LONGITUDINAL STATIC STABILITY & MANEUVERING FLIGHT DEMO (FTE/N)

REFERENCES:

1. Flying Qualities Textbook, Chapter 6: Introducing the Flying Qualities Military Standard and Chapter 8: Trim and Stability
2. MIL-STD-1797A

PURPOSE:

1. To demonstrate and practice the FTT used to obtain longitudinal static stability (F_s/V) data for MIL-STD-1797A compliance. Two techniques will be examined.
    a. Acceleration/Deceleration
    b. Stabilized

2. To demonstrate the FTT used to obtain flight path stability (γ_{PA}/V)

3. To demonstrate the flight test techniques used to obtain F_s/n, δ_s/n, and δ_e/n data.

AIRCRAFT:

C-23

LIMITATIONS:

As listed in the aircraft handbook/Technical Order.

MISSION EVENTS:

1. Mission Preparation.

FTE/N: Prepare data cards for the mission and reproduce copies for the IP and Duty Desk. All data will be collected using hand-held techniques. The FTTs will require using a hand-held force gauge, sensitive G meter, and a cloth tape measure or calibrated string is required for δ_S. Normally two FTE/N will be scheduled together for this flight. The two non-flying crewmembers will be reseated in-flight in order to shift the airplane center of gravity.

2. Brief.

IP: Brief the entire mission with emphasis on attitude flying, reversible control system, unusual attitudes, recoveries and symmetric/unsymmetric G limitations.

3. Ground Block.

FTE/N: Perform a stability and control ground block (EAR check) to simulate DAS operations.

4. Takeoff/Climb.

IP: Perform a normal takeoff. Qualitatively evaluate F_s and δ_s from brake release through acceleration to climb speed. Note effects of configuration changes on F_s and δ_s. During the climb, student will practice elevator trim usage and power setting procedures.

5. Trim Shot (8,000 ft MSL, 120 KIAS, CR).

FTE/N: obtain a trim shot at the conditions listed or as dictated by flight conditions. Investigate friction and breakout forces by lightly forcing wheel until first nose movement is detected. With a reversible control system, this may need to be investigated at each test condition.

6. Stabilized Method.

a. IP: Demonstrate stabilized test method at V_{TRIM} ±15% in 5 to 10 knot increments. On the first point, raise the nose to reduce the airspeed. Once the airspeed has dissipated, adjust the nose position to a point on the horizon to hold the airspeed. At this point you may be anywhere in the friction band. Carefully release back pressure until the nose starts to drop. This marks the front side (or push) of the friction band. Next, come back slowly on the wheel until the nose is returned to the attitude to hold the airspeed constant. You should now be on the back side (or pull) of the friction band at constant airspeed and pitch/stick force. At airspeeds less than trim, the data should be taken on the back side and vice versa. After the stabilized point at V_{TRIM} - 15%, push over to get the V_{TRIM} +15% point, then relax the push to do slower points. As you are attempting to locate the front side of the friction band, you will note that the nose will be quite unstable on the horizon. To obtain valid data the wheel must be on the correct side of the friction band and absolutely frozen at the time of eventing with the airspeed and pitch steady.

b. FTE/N: Perform stabilized points as above with same trim and power setting. Trying to reset throttles is imprecise, so power should not be changed unless absolutely necessary until the test is completed. Data band is ±2,000 ft. The fast/front side points may be done prior to the slow points if required to remain within the data band. Each FTE/N will collect data at a different CG and the results will be compared. CG will be shifted by reseating the non-flying crewmembers.

7. Hand-Held Force Gauge - Student Practice.

FTE/N: Practice the stabilized FTT attempting to obtain force measurements using the hand-held force gauge. The IP will demonstrate use of this gauge.

8. Trim Shot. Student: Perform trim shot same as Step 5.

9. Level Acceleration/Deceleration Method.

a. IP: Demonstrate the level acceleration/deceleration method. The maneuver will be performed in level, or near level flight at V_{TRIM} ±15% KIAS, as specified in MIL-STD-1797A. Note trim power, then reduce RPM or use drag devices as required to decelerate. As the aircraft decelerates and pull forces are sensed, maintain the back side of the friction band. At approximately V_{TRIM} - 20%, simulate turning the data system on and reset trim power. Note any differences in pitch forces due to power addition. Decreasing pull forces will be sensed until near the trim airspeed. After the acceleration back to trim airspeed, turn off the data system and advance RPM as required to accelerate to V_{TRIM} +20%. As the aircraft accelerates, increasing push forces should be felt. Maintain the front side of the friction band throughout this maneuver. Reset trim power, simulate turning the data system on and decelerate to trim airspeed. Very light wheel forces, normally less than 10 pounds maximum, will be encountered. This fact, combined with a friction band of about 2 pounds, dictates that the maneuver be performed very smoothly with consistent wheel force application. Be aware of sideslip in these maneuvers.

10. Trim Shot.
Student: Perform trim shot at 8000 ft MSL, 135 KIAS (CR).

11. Stabilized G Method.

a. IP: Note trim power. Begin constant airspeed maneuver. Stabilize at ϕ = 15°, 30°, 45° and 60° (aircraft limit). Hold the wheel on the back side of the friction band at each point. Freeze the wheel when recording data. Attitude flying should be stressed during the maneuver with a cross-check of airspeed. Remember there may be slightly less than 2.0Gs at 60° bank due to the descent. If bank angle limit is not reached by the time the bottom of the altitude band is passed, climb back up, reset trim power and continue with the next bank angle (Data Band: ±2 KIAS, ±1,000 ft). Note: High performance aircraft data band is ±2,000 ft.

b. FTE/N: Practice stabilized G method.

12. Slowly Varying G Method.

a. IP: Demonstrate slowly varying G method. Altitude band, trim setting and airspeed criteria remain the same as for the stabilized G method. Attempt to keep load factor increasing at no more than 0.2G/sec to minimize dynamic effects. This rate is particularly critical past 45°. Again, attitude flying should be stressed.

b. FTE/N: Practice slowly varying G technique.

13. "Pullup" Method.

a. IP demo the pullup maneuver at the same trim conditions. Re-establish the trim shot at the test altitude. Leave power set and pull up to exchange airspeed for altitude. Perform 1.3G and 1.7G pullups. Dive angle and airspeed lead depend on aim load factor. Maneuvers may be practiced one after another. Wheel force and load factor must be constant at reading. A load factor within +0.2Gs of aim load factor is valid if it is constant. Varying stick force and load factor just before reaching horizon in an attempt to achieve aim load factor will invalidate data. If stick force is never relaxed during pull, it is assured the stick is on the back side of the friction band (Data Band: ±5 KIAS, ±1,000 ft, within ±10° of level flight).

b. FTE/N: Practice pullup technique.

c. IP/FTE/N: Use hand held force gauge and tape measure during another pullup set to get F_s/G, δ_s/G data. Make an in-flight plot.

14. Flight Path Stability Demonstration.

a. IP: Demonstrate the flight path stability test technique. Begin by establishing final approach speed (V_{omin}) in the PA configuration for the aircraft type you're flying. Do this at least 500 ft above the top of the data band. The data band is a maximum of 2,000 ft vertical height in smooth air. Next reduce power and establish a rate of descent equivalent to a 3° glide slope for your aircraft type. Once the power is set, do not move it throughout the remainder of this test. When passing the top of the data band, record the airspeed, altitude, outside air temperature, and rate of descent. Next, using the wheel alone, increase airspeed 5 knot and record the same parameters. If the airspeed varies as much as one knot it will destabilize the R/D. Changes in altitude at the same V_{omin} will also affect R/D so the test points should be obtained rapidly. The altitude is recorded at each test point to allow a correction factor to be applied to the R/D.

b. FTE/N: Perform flight path stability test at V_{omin}, +5, -5, -10, V_{omin}. After the power is set for the initial V_{omin}, the remaining points must be completed within the data band with no power changes. The R/D at the test points may vary from day to day due to atmospheric changes with altitude but there should be a noticeable decrease in R/D from the initial V_{omin} to the final one. If turbulence or excessive wind shear are experienced, the data is obviously invalidated, so use some judgment on when to curtail the test and go on to the remainder of the mission.

15. Landing.

IP: Perform a normal landing. Estimate F_s and δ_s required during final approach, flare and landing roll out.

16. Ground Block.

Student: Obtain a post-flight stability and control ground block.

17. Debrief.

IP: Debrief entire mission with emphasis on mission planning, FTT performance and quality of data.

INSTRUMENTATION:

All data collection will be with hand-held force gauge, cloth tape measure or simulated.

DATA REDUCTION/REQUIRED PLOTS:

In-flight plots:

a. F_s vs V_c - Stabilized Method (use force gauge)

b. δ_s vs V_c - Stabilized Method (use tape measure)

c. R/D_i vs V_c - Flight Path Stability

DATA REDUCTION/REQUIRED PLOTS:	INSTRUMENTATION:
1. F_s VS G - pullup technique.	1. Hand held force gauge.
2. δ_s VS G - pullup technique.	2. Tape Measure.
3. δ_s VS F_s - pullup technique.	3. Sensitive G meter.

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LATERAL-DIRECTIONAL STABILITY DEMO (P/FTE/N)

REFERENCES:

1. Flying Qualities Textbook, Chapter 6: Introducing the Flying Qualities Military Standard and Chapter 8: Trim and Stability
2. MIL-STD-1797A

PURPOSE:

To demonstrate and practice flight test techniques used to investigate the static lateral-directional stability characteristics and roll characteristics of an aircraft. Techniques will be demonstrated to determine MIL-STD-1797A compliance (consider C-23a Class II-L aircraft).

AIRCRAFT:

C-23

LIMITATIONS:

As published in the Flight Manual.

MISSION EVENTS:

1. Mission Preparation.

This sortie will normally be flown with one pilot and one FTE/N. Each student will plan to fly all test points. The IP will plan seat swaps to ensure all training objectives are met. Pilot/FTE/N: prepare data cards for the entire flight profile and provide copies for the IP.

2. Brief.

IP: Brief the flight profile including test techniques, data required, reversible flight control system, turboprop characteristics, and instrumentation use.

3. Ground Block.

Position the wheel to approximately ¼, ½, and ¾ deflection. Mark each position on the wheel housing with masking tape and a pen. The pilot should practice making ¼, ½, ¾, and full deflection aileron inputs while taxiing. Also measure the full wheel throw angle to verify that full aileron displacement will comply with the MIL-STD- 1797A maximum wheel displacement requirement (4.5.9.1 recommends no more than 60° throw for wheel controllers, with 110° allowed for completely mechanical systems).

4. Takeoff/Climb.
Pilot: Perform the takeoff and climb in the most efficient manner to set up for the first test point.

5. Trim Shot (6000-10,000 feet MSL as desired, 120 KIAS) CR Configuration TLF. Pilot: Obtain a trim shot ensuring that the sideslip indicator is centered.

6. Aileron Roll FTT.

a. IP: Demonstrate the aileron roll flight test technique used to evaluate MIL-STD-1797A requirements (4.5.8.1). Using trim power and holding 120 KIAS, roll the aircraft into a 25° bank. Stabilize the aircraft in this condition. Rapidly move the yoke to 1/4 deflection, until the aircraft rolls to 20° of bank in the opposite direction. In order to insure a full 45° bank angle change (note Class III and IV have different bank angle change requirements from the C-23), the IP should not start to terminate the roll until after 20° of bank angle in the opposite direction has been exceeded.

The control input at the beginning of the maneuver should be a "step input." The pitch control should be fixed throughout the maneuver. When the roll is complete, rapidly reestablish a 25° bank at 120 KIAS. This will prevent needless altitude loss and airspeed excursion. Repeat the procedure in the opposite direction. When the aircraft has been rolled in both directions at 1/4 deflection, repeat the procedure at ½ and 3/4 yoke deflection. Remember, the military standard allows the use of coordinated rudder (except for Class IV aircraft) if "simple, easily coordinated with roll control inputs and consistent with piloting techniques for the aircraft class and mission." Finally, make a roll test at 60°/110° yoke throw (full yoke deflection) to check for MIL-STD-1797A, para 4.5.9.1 compliance. For demonstration sake, the instructor pilot may roll in only one direction for each control deflection tested. The altitude band for aileron rolls will be $\pm$1,000 ft.

There are various MIL-STD-1797A requirements satisfied using this FTT. The aileron roll FTT can be used (no rudder coordination allowed for Class IV aircraft) to evaluate several MIL-STD paragraphs. First, the aircraft should roll through the required bank angle change in a specified maximum time (para 4.5.8.1). Second, the roll response variation with roll control deflection or force shall not have any objectionable nonlinearities (para 4.5.3). Third, the roll control force necessary to achieve the maximum specified time to roll should not exceed a specified maximum value. This is not the same as specifying the maximum roll control force achievable. Finally, the aileron roll FTT can demonstrate compliance with para 4.5.9.3 by measuring the aircraft's roll control force gradient.

b. Pilot/FTE/N: Practice the aileron roll test in both directions. Use a stopwatch to measure ϕ_t (time for bank angle change).

Note: Class IV aircraft may require measurement of 360° roll performance. The technique is the same - a rapid, full control input held through 360° of roll. In order to determine exactly how much aileron force is required to hold full aileron deflection when using instrumentation, slowly relax the control force after completing 360° of roll.

7. Turn Coordination.

Make a 45° bank stabilized turn at the previous trim settings/conditions and use rudder to coordinate the turn. Pedal force should be less than 40 pounds to accomplish this (para 4.6.7.2). Next, remove all rudder inputs and apply aileron as required to hold the 45° bank turn. Yoke force should be less than 10 pounds for this condition (para 4.5.9.5.1). Estimate all forces. Note: This test is done at 60° bank for Class IV airplanes with different force thresholds than the C-23.

8. Directional Control with Speed Change - P Factor.

Pilot/FTE/N: Begin at the 120 KIAS trim conditions and then raise the nose, slowing to 90 KIAS (remain above 1.1 V_s). Note the F_r required to center the ball, wings level. F_r should be less than 100 pounds with a 30% speed change from the trimmed condition (MIL-STD-1797A, para 4.6.7.3). The propeller disk loading will shift as angle-of-attack changes resulting in a lateral force change. This force change must be controllable within the pilot's capabilities. Estimate all forces.

9. Trim Shot (6,000 to 10,000 ft MSL as desired, 100 KIAS/Flaps 15°, PA).

Obtain a zero sideslip trim shot using the back side trim technique.

10. Stabilized SHSS Technique.

a. IP Demo: The instructor pilot will demonstrate the stabilized sideslip flight test technique. Starting from a zero sideslip condition, establish a steady straight sideslip using 1/4 δ_r while holding trim airspeed. This may best be done by applying a small amount of rudder and then coming in with just enough bank to hold the turn needle centered or to eliminate any heading shift. As the C-23 has no turn needle installed, checking an outside reference point or the heading indicator will help insure the aircraft remains stationary. A point on the horizon will provide the pilot with the most accurate means of holding a constant heading. It is not necessary that the same point on the horizon be used for each stabilized point. Constant trim airspeed should be maintained as the sideslip is increased until reaching the maximum sideslip obtainable. Exact increments are not important-- the objective is to obtain three to four different stabilized points in each direction.

Position error due to sideslip may result in inaccurate data if the indicated airspeed is held constant. An indication of the magnitude of this error can be obtained by releasing the

rudder rapidly in a controlled fashion that prevents overshoots through the zero sideslip condition. When the aircraft comes back to zero sideslip, note the magnitude of the airspeed change. (example: if the airspeed reads 160 Kts in the sideslip but reads 170 Kts when released to zero sideslip, there is approximately a 10 Kt error. Correct by flying 150 Kts while in the sideslip to get 160 Kt data.) This correction can be ignored if the change is only one or two knots. Also, note the change on the heading indicator when the sideslip is released. Use this method to estimate sideslip angles when evaluating aircraft without special instrumentation. Required forward or aft stick to hold a constant airspeed as the sideslip is increased should be immediately apparent. Thus, the correct control movement can be anticipated as the sideslip is increased, improving your control during test point entry and exit. Control inputs should be slow and deliberate to keep Dutch roll at a minimum and to keep to keep yaw rates low.

CAUTION

EXCESSIVE YAW RATES AT HIGH SIDESLIP ANGLES IN ANY AIRCRAFT MAY LEAD TO DEPARTURE FROM CONTROLLED FLIGHT DUE TO DIRECTIONAL DIVERGENCE, WING/FIN STALL OR RUDDER LOCK.

After the maximum sideslip point is reached, the aircraft should be smoothly returned to trim and then similar sideslip points should be made in the opposite direction. Smoothness in this test, as in all tests, is imperative in order to get good stabilized points quickly and to maintain aircraft control. Anticipating correct control movements is a great aid in establishing good test points quickly. Be sure to collect all required data for each point (β, F_a, F_r, F_e, ϕ, δ_a, δ_r, δ_e). Estimate all forces.

b. The Pilot/FTE/N will practice the stabilized sideslip flight test technique. Maintain trim altitude $\pm$1,000 feet. Again, exact increments of sideslip are not required. The student should get three to four stabilized points in each sideslip direction.

11. Slowly Varying SHSS Technique.

a. IP: Demonstrate the slowly varying sideslip method. This is an alternate method of obtaining sideslip information, and is especially well-suited to instrumented aircraft. Starting from zero sideslip, continuously increase the sideslip angle at not more than one-degree per second while maintaining heading and airspeed. Slowly and steadily increase rudder pressure and displacement (avoid reversals) to maintain the velocity vector stationary with respect to a point on the horizon. Data would normally be collected continuously out to the maximum sideslip angle. This method is considerably more difficult to fly properly than the stabilized

sideslip method.

b. The Pilot/FTE/N will practice the slowly varying sideslip method.

Though not demonstrated in this sortie, a variation of the steady heading sideslip is the wings-level sideslip. During this FTT, the sideforce generated by the sideslip will not be balanced by the lift vector and the pilot will experience some lateral acceleration. The wings level technique is most commonly used with instrumented aircraft that can sense the resulting N_y for use in the data reduction.

12. Seat Swap (as required).

The FTE/N will accomplish test points demonstrated to the pilot.

13. Landing/Taxi.

Pilot: Perform a normal landing. Qualitatively note F_r, δ_r, F_a and δ_a during approach and landing roll. Evaluate ground handling characteristics.

14. Debrief.

IP: Debrief the flight on mission planning, FTT performance and quality of data.

INSTRUMENTATION:

1. Masking tape for marking yoke throw.
2. Stopwatch.

DATA REDUCTION/REQUIRED PLOTS:

In-flight Plots:

a. θ_t vs δ_a - ¼, ½, ¾, 60°/110° (have ϕ_{tmax} on plot).

b. F_r, δ_r vs β - plot estimated data to get a feeling for direction and linearity of control inputs during stabilized sideslips (para 4.6.1.2).

c. F_a, δ_a vs β - same as b.

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DYNAMICS DEMO (PILOT)

REFERENCES:

1. Flying Qualities Textbook Supplementary Material
2. MIL-STD-1797A

PURPOSE:

1. To demonstrate the flight test techniques used to excite the various dynamic modes of an aircraft to include:
    - a. Short period
    - b. Roll rate oscillations
    - c. Dutch roll
    - d. Spiral mode
    - e. Phugoid
    - f. Bank angle oscillations
    - g. Roll rate ratcheting

These techniques may be used to gather data for MIL-STD-1797A compliance.

2. To demonstrate the effect of the control augmentation system (CAS) of the F-15 to improve dynamic handling qualities.

3. To demonstrate Mach number and dynamic pressure (q) effects on the dynamic responses of an aircraft (See Figure 3.1).

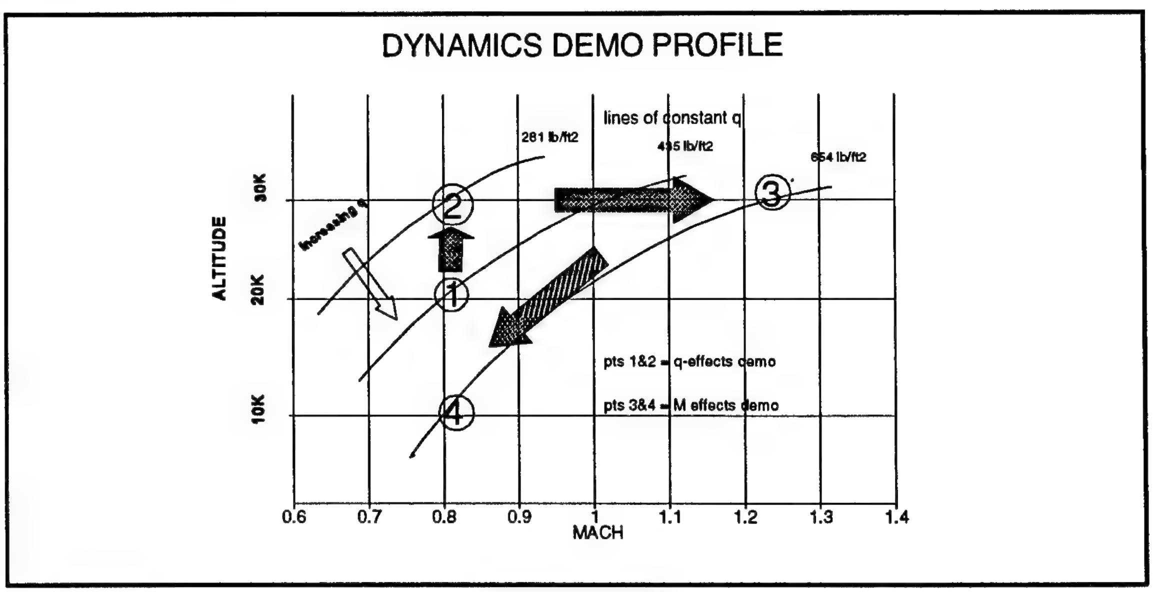

FIGURE 3.1

4. To demonstrate the techniques used in flight to obtain qualitative data from observing responses of the aircraft.

5. To practice the concept of build-up approach and envelope expansion.

AIRCRAFT:

F-15B/D

LIMITATIONS:

1. Normal Flight Manual limits.
2. Be aware of PIO tendencies at low altitude and high Mach number.

MISSION EVENTS:

1. Mission Preparation.

The pilot is responsible, within the constraints of the mission card, for flying an efficient mission profile with special emphasis on the transitions between test points. Prepare a data card for the mission which will facilitate data recording in-flight. Present a copy of this card to the IP. Card should contain qualitative predictions for each test condition.

2. Briefing.

IP: Conduct the briefing.

3. Ground Block.

Student: Perform a FQ ground block.

4. Takeoff.

Student: Perform a Mil power takeoff and climb to 20,000 and 0.8 IMN as efficiently as possible.

5. Trim Shot (20,000 ft MSL, 0.8 IMN Cruise configuration [CR]). (q=435 PSF)

Student: Perform a trim shot at 20,000 ft MSL, 0.8 IMN.

6. Short Period.

a. Student: Attempt one doublet with the pitch CAS on to evaluate augmented dynamics. Perform a rough trim shot at trim point, then turn pitch CAS off and refine the trim shot. Coordinate with the IP each time any CAS axis is disengaged.

b. IP: Demo short period. The IP will demonstrate impulses, step inputs, singlets and doublets to attempt to excite the short period of the A/C. The objective here is to start with small, slow inputs and work up. Remember, one only needs sufficient amplitude to observe the pitching motions. The merits of each excitation technique will be evaluated by the student. The

IP will demonstrate the methods to count overshoots and to time the period of the response. A stick-free input method will be used.

c. Student: Practice the various short period inputs and record the period and overshoots.

7. Bank Angle Oscillations (20,000 ft MSL, 0.8 IMN, CR).
Student: Perform a trim shot at 20,000 ft, 0.8 IMN with all CAS reset. After stabilizing in approximately 15° of bank, apply an aileron impulse (yaw-control-free) and release the control. This impulse should be at the maximum rate and at the largest deflection possible. Modify the initial bank angle (if necessary) so that the resulting aircraft motion is a bank oscillation about the wings-level position. Turn roll and yaw CAS off, refine the trim shot, and repeat the maneuver, noting any differences in response.

8. Dutch Roll Mode.

a. Pilot: Obtain a trim shot at 20,000 ft MSL, 0.8 IMN with all CAS reset.

b. The IP will turn off the roll and yaw CAS and demonstrate the various inputs to excite the Dutch roll. These are impulses, steps, singlets, doublets, and sideslip releases (all rudder-free). The IP will also demonstrate the methods to count overshoots, time the period, and obtain the ϕ/β ratio.

c. Pilot: Retrim with all CAS reset.

d. Student practice the inputs used to excite the Dutch roll mode. This will be done with CAS on, roll CAS off and then will both roll and yaw CAS off. Record the period, the overshoots and the ϕ/β ratio.

9. Spiral Mode Student Practice.
Student: Obtain a good trim shot at 20,000 ft MSL, 0.8 IMN with special emphasis on the lateral trim. Then investigate the spiral mode by releasing the aircraft from a 20° bank angle. Time the motion to double amplitude or 20 seconds, whichever occurs first. Note the bank angle at both 12 and 20 seconds for MIL-STD compliance. Note any change in airspeed. Perform this maneuver in both directions with the roll CAS on and off.

10. Trim Shot (30,000 ft MSL, 0.8 IMN). (q=281 PSF)
Student: Obtain a good trim shot at 30,000 ft MSL, 0.8 IMN.

11. Phugoid Mode, Student Practice.

a. Student: Investigate the phugoid mode. With all pitch CAS off and Pitch Ratio switch to "Emergency" smoothly raise the nose and wait until the airspeed decreases 10 to 15 knots. Then return the aircraft to the trim shot attitude and stabilize. Hold wings level (note heading)

throughout the maneuver without inducing pitch changes. The VVI is the most accurate and repeatable way to observe the period, however, the altimeter can also be used. The period will be timed on the VVI reversals or altimeter reversals. Divergence or convergence will be determined by comparing the airspeed and altitude on the top and bottom of at least two cycles (i.e 5 VVI reversals).

b. An alternate entry technique is available to investigate the phugoid mode. After performing the trim shot and while holding the stick fixed (so as not to impart any stick dynamics), extend the speed brake and decelerate 10 to 15 knots. Reset the speed brake and release the stick. Data is gathered in the same manner as above.

12. Dynamic Pressure Effects, Student Practice (30,000 ft MSL, 0.8 IMN,CR).
The pilot will investigate the short period and Dutch roll. Short period will be investigated with the pitch CAS on and off. The Dutch roll will be investigated with the roll/yaw CAS on and off. Record the appropriate data and compare the results with the data obtained at 20,000 ft MSL.

13. Supersonic Effects on Dynamics, Student Practice.

a. Trim at 30,000 ft MSL at 1.22 IMN. (q=654 PSF)

b. Investigate the short period and Dutch roll independently with CAS on and off. Record the appropriate data.

CAUTION

PITCH CONTROL IN THIS REGIME IS VERY SENSITIVE, AND PIO MAY OCCUR.

14. CAS Effectiveness, Investigation, Student Practice.
While descending from the supersonic run locate a target and track it using a spot on the windscreen. Then rapidly raise the nose and track another target. Then turn off the pitch CAS and repeat the process. Do the same thing in the lateral direction with roll/yaw CAS on and off. Quickness and stability of pointing are the items of interest. Students should closely monitor Mach number in the dive, and be aware of pitch sensitivity with CAS off.

15. Trim Shot (10,000 ft MSL, 0.8 IMN, CR), Student Practice.

16. Mach Number Effects on Dynamics.
Investigate the short period and Dutch roll with CAS on and off as in previous events (q at 30,000 ft MSL, 1.22 IMN is equal to q at 10,000 ft MSL at 0.8 IMN which is 654 PSF). Record the appropriate data.

17. Roll Rate Oscillations (10,000 ft MSL, 160 KCAS, CR).
Student: Investigate the roll rate oscillations for small inputs at 10,000 ft and 160 KCAS with the rudder pedals free and roll and yaw CAS on and off (fuel permitting). Establish a 30-degree bank in either direction and apply a small step aileron input so as to roll in the other direction. Observe and analyze roll rate oscillations (a "ratcheting" roll or roll reversals).

18. Dynamics (10,000 ft, 160 KCAS, CR), Student Practice.
Investigate the short period and Dutch roll with CAS on and off, as in previous events. Record the appropriate data.

19. Dynamics (10,000 ft, 160 KCAS, PA), Student Practice.
Investigate the short period and Dutch roll in the PA configuration with CAS on and off, as in previous events. Investigate the Phugoid mode with pitch CAS off. Record the appropriate data.

20. Spot Landing, Student Practice.
Student: Perform a spot landing using a normal 21 unit AOA approach. Fuel permitting, repeat the maneuver using a minimum landing run technique of 23 units.

21. Debriefing.

INSTRUMENTATION:
A stopwatch and standard cockpit instrumentation are sufficient for this mission. Data will be hand recorded.

DATA REDUCTION:
The student should compute observed frequency and should estimate the damping ratio for the appropriate dynamic modes after this flight. Compare and analyze the changes in the frequencies and periods observed at the different conditions with the changes predicted by the theory.

REQUIRED PLOTS:
No plots are required from this flight.

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FLYING QUALITIES DEMO (FTE/N)

REFERENCES:

1. Flying Qualities Textbook
2. MIL-STD-1797A

PURPOSE:

To allow each FTE/N to gain an understanding and appreciation of the flight test techniques (FTTs) used in FQ testing, especially those used for model validation, MIL STD dynamic stability, and handling qualities. Each FTE/N should get "hands on" experience with these techniques.

AIRCRAFT:

T-38 plus suitable target (required). DAS may be simulated.

LIMITATIONS:

As listed in the Flight Manual.

MISSION EVENTS:

1. Mission Preparation.

Each FTE/N will be responsible for allocating time and fuel and determining the sequence for the mission events using the aircraft Flight Manual with special emphasis on moving efficiently from point to point. The FTE/N will prepare a set of data cards. However, the IP has the option of rearranging the cards and sequence of events. Each student should review the FTT notes for each of the techniques that will be demonstrated.

2. Briefing.

The FTE/N will be responsible for the specific mission briefing, including the mission profile and sequence of events. The IP will be briefing each test technique to be demonstrated, including coordination with the target aircraft and Air to Air/Air to Ground Rules of Engagement (ROE).

3. Ground Block.

The IP will demonstrate the ground block.

4. Military/Maximum Power Takeoff.

The IP will demonstrate the takeoff. The target may perform an interval, formation, or

airborne pickup with the test aircraft.

5. Military Power Climb.
The IP will demonstrate and FTE practice a military power climb at 350 KIAS.

6. Flight Test Techniques.
The IP will demonstrate and FTE practice (where possible) the following FTTs (not necessarily in this order) and data recording techniques according to procedures outlined in appropriate subsections of Section 3, Flying Qualities Phase Planning Guide (see previous sections for FTT description of items a-e):

a. Phase 1, 2, and 3 handling qualities testing (air to air, air to ground, and close formation). See Handling Qualities Demo for criteria and techniques. In addition, a pop-up attack air to ground pattern and/or formation landing may be demonstrated as Phase 3 maneuvers. See Operational Handling Demo for details on the pop up pattern.

b. MIL STD Dynamic Stability test techniques (pitch and yaw doublets to excite short period, Dutch roll; spiral mode stability; phugoid mode stability). Maneuvers may be demonstrated yaw damper on and off as required.

c. Maneuvering Flight (IAW grade sheet, Appendix A)

d. Aileron Rolls (IAW grade sheet, Appendix A)

e. Steady heading sideslip (IAW grade sheet, Appendix A)

f. (Optional) Aero Model Validation techniques (doublets and sweeps to verify stability derivatives and frequency response). Will be covered in-depth on Model Validation FTT, though FTE/Ns will be in the TM room.

7. Landing.
The IP will perform the landing.

8. Mission Debrief.
Include any comments on the maneuvers and how they might apply to the fighter trainer mission of the aircraft.

INSTRUMENTATION:
None.

DATA REDUCTION:
None.

MULTI-ENGINE FLYING QUALITIES DEMO (P/FTE/N)

REFERENCES:

1. Flying Qualities Textbook
2. MIL-STD-1797A
3. Starlifter Guide

PURPOSE:

1. To demonstrate, practice and apply the flight test techniques from the flying qualities phase in a heavy multi-engine aircraft.

2. To practice on-board mission directing and crew coordination.

AIRCRAFT:

C-141A (61-2775 desired), tanker (desired for simulated refueling)

LIMITATIONS:

1. Test Limits:
   - 0 to 2.0 g (60° bank maximum)
   - Vmax = 330 KCAS/0.78 Mach
   - Vmin = shaker onset (computed or actual)
   - Maximum 3/4 yoke for roll performance
   - Maximum 1/4 rudder or half yoke for Dutch roll
   - 500 ft AGL minimum for low level
   - 50 ft minimum from tanker for boom tracking (HQDT, Phase 2 HQ)
   - 10 ft minimum from boom for simulated air refueling (Phase 3 HQ)
   - Maximum of 15 degrees sideslip (no aircraft limit)
   - Other aircraft flight manual limitations will apply.

2. Only flight test techniques from the Flying Qualities textbook will be used.

GENERAL:

1. Students *not* in the C-141 Flying Qualities Data Group will normally fly a single 3.5-hour sortie with one or two pilots and one or two FTE/Ns. See mission cards for Multi-Engine Demo (ME Demo) in Appendix A. This demo consists of both open-loop maneuvers designed to determine MIL-STD-1797A compliance (Class III aircraft) and closed loop handling qualities maneuvers (Phase 1, 2 and 3).

NOTE: Students in the C-141 Flying Qualities Data Group will not normally fly these sorties.

2. The students should pay close attention to the aircraft's handling qualities and how they relate to the transport mission of the C-141. Keep in mind inertia effects, heavier control forces, ease of set ups and transitions between test points. Consideration should also be given to area planning and crew coordination.

MISSION EVENTS:

1. <u>Mission Preparation.</u>

The test team will prepare data cards from the events listed on the Grade sheet in Appendix A. The order of events on the mission card can be changed, if desired, in order to fly an efficient mission profile. If two pilots are scheduled for the same sortie, an equitable number of test points will be flown by each pilot to ensure training objectives are met. FTE/Ns will normally direct the mission from the jump seat. There is an additional FTE station on the instrument pallet in the cargo compartment. FTE/Ns may fly some points up-and-away, time permitting.

2. <u>Briefing.</u>

The instructor pilot will brief the general mission including unique aspects of airdrop or air refueling. The student test team will be prepared to discuss the type of FTTs, data procedures, tolerances and key parameters. The aircraft will be evaluated as a Class III aircraft for MIL STD compliance. The first part of this sortie will show you some of the open loop characteristics of the aircraft in preparation for closed loop tasks that you will do later in the flight.

3. <u>Ground Block.</u>

Note the greater friction and breakout forces when compared to smaller, Class IV aircraft. IP will demonstrate use of force gauge and tape measure (if required). The yoke should be marked to allow precise inputs for roll performance tests.

4. <u>Takeoff(Reduced EPR).</u> During configuration changes (gear/flaps up, spoilers in/out) pay particular attention to forces in the longitudinal axis. MIL STD allows no more than 50 lbs push or pull.

5. <u>Trim Shot.</u> (15,000 ft, 250 KCAS, CR). It is especially important in a large, multi-engine aircraft to follow a set procedure when trimming:

(1) Align thrust on all engines--in the C-141, EPR is the best indication of thrust. Ensure EPR is aligned vs the actual throttle position.

(2) Center the "ball" (or yaw string if available) using rudder trim. Rudder trim "paddles" on center pedestal between pilots.

(3) Achieve wings-level with aileron trim. Aileron trim located right above rudder trim.

(4) Patience!

6. Speed Stability (15,000 ft, 250 KCAS, CR).
Use the accel/decel method to investigate speed stability. Speed band is +\- 40 KCAS about trim (40 KCAS is approximately 15% of trim speed). The C-141 feel spring in the pitch axis varies as a function of dynamic pressure. Note power effects (underslung engines) as you reset trim power to begin your accel or decel.

7. Maneuvering Flight (15,000 ft, 250 KCAS, CR).
Investigate stick force/g using the stabilized or slowly varying method, and pullup/pushover method. For the stabilized/slowly varying method, do not exceed 60° bank during the investigation or recovery (60° is an aircraft limit). For the pullup/pushover method, limit investigation to 0 - 2.0 g (aircraft limit -1 to 2.5 g). For the pullup maneuvers, one technique is to use about 5° dive angle with a 5-10 kt lead. For the pushovers, a 5° climb with a 5 kt lead is sufficient. Ensure all loose items are secure and rest of crew is restrained prior to any of these maneuvers.

8. Trim Shot (25,000 ft MSL, 275 KCAS, CR).
This is representative of air refueling altitude and speed that will be investigated in a closed loop task with the tanker.

9. Short period/Phugoid (25,000 ft MSL, 275 KCAS, CR).
Investigate the short period characteristics (phugoid optional). The short period may be preceded by an N/alpha sweep to determine best input for the pitch doublet. Phugoid may be excited though airspeed reduction using either pitch or spoilers.

10. Dutch roll (25,000 ft MSL, 275 KCAS, CR).
Different methods may be used to excite the Dutch roll--rudder singlet, rudder doublet, aileron pulse/doublet or a release from steady heading sideslip. The Dutch roll is a major mode of motion evident in all handling qualities tasks in the C-141. Investigate yaw damper on and off.

CAUTION

MAKE SMALL INPUTS (MAX 1/4 RUDDER OR ONE HALF LATERAL YOKE) TO PREVENT EXCESSIVE TAIL LOADS.

11. Roll Performance (25,000 ft MSL, 275 KCAS, CR).
Investigate roll performance using incremental step yoke inputs (max of 3/4 lateral yoke), yaw damper on (off optional). Rudder may be used to reduce sideslip that retards roll rate. Time through 30 degrees of bank angle change (15° - 15° for Class III aircraft). Pay attention to adverse yaw and any apparent roll rate oscillations. Like the Dutch roll, the roll rate of the C-141 plays a large effect on its handling qualities, especially during high "gain" pilot tasks.

12. Boom Tracking/Simulated Air Refueling (25,000 ft, 275 KCAS). No actual air refueling will be performed since the C-141A does not have an AR receptacle. However, if available, a tanker target is an excellent tool to reveal handling qualities characteristics not as evident with merely open loop, low bandwidth testing. Boom tracking (a Phase 2 maneuver) and simulated air refueling (a Phase 3 maneuver) will be performed if a tanker is available. The boom tracking task will be flown from no closer than 50 ft (precontact position) to ensure adequate aircraft clearance. During simulated air refueling, you may close to 10 ft from the boom, but a good rule of thumb is to always keep the boom in sight.

(1) Phase 1 HQ. First, stabilize at the pre-contact position (approximately 50 ft aft of the tanker) and get accustomed to flying behind the tanker. Make an initial assessment of the aircraft's handling qualities.

(2) Phase 2 HQ. With a pipper (cross, etc) drawn on the windshield, perform an HQDT boom tracking task. At approximately 50-100 ft aft of the boom nozzle, attempt to keep the pipper on the nozzle with zero error as the boom operator moves the boom at approximately 1 deg/sec (2 deg/sec maximum). To increase pilot gain, have the boom operator move the boom in random directions horizontally, then vertically, and finally in all axes. Adhere to flight manual G limits. Pilot comments should include PIO susceptibility, aircraft response, control forces and deflections.

CAUTION

THE TASK SHOULD BE DISCONTINUTED IF THE C-141 APPROACHES WITHIN 10 FEET OF THE BOOM OR IF DIRECTED BY EITHER THE C-141 IP OR TANKER BOOM OPERATOR. TERMINATION ("BREAKAWAY") SHOULD BE ACCOMPLISHED BY RETARDING THE THROTTLES TO IDLE (NO SPOILERS), PUSHING OVER, AND MAINTAINING/ROLLING WINGS LEVEL, WHILE THE BOOM OPERATOR MANEUVERS THE BOOM AWAY FROM THE C-141.

(3) Phase 3 HQ. Stabilize 20 to 50 ft aft of the boom nozzle and perform an operational handling maneuver, which simulates air refueling. Attempt to keep the boom nozzle between the two rows of Pilot-Director Indicator (PDI) lights on the tanker and abeam the "captains bars."

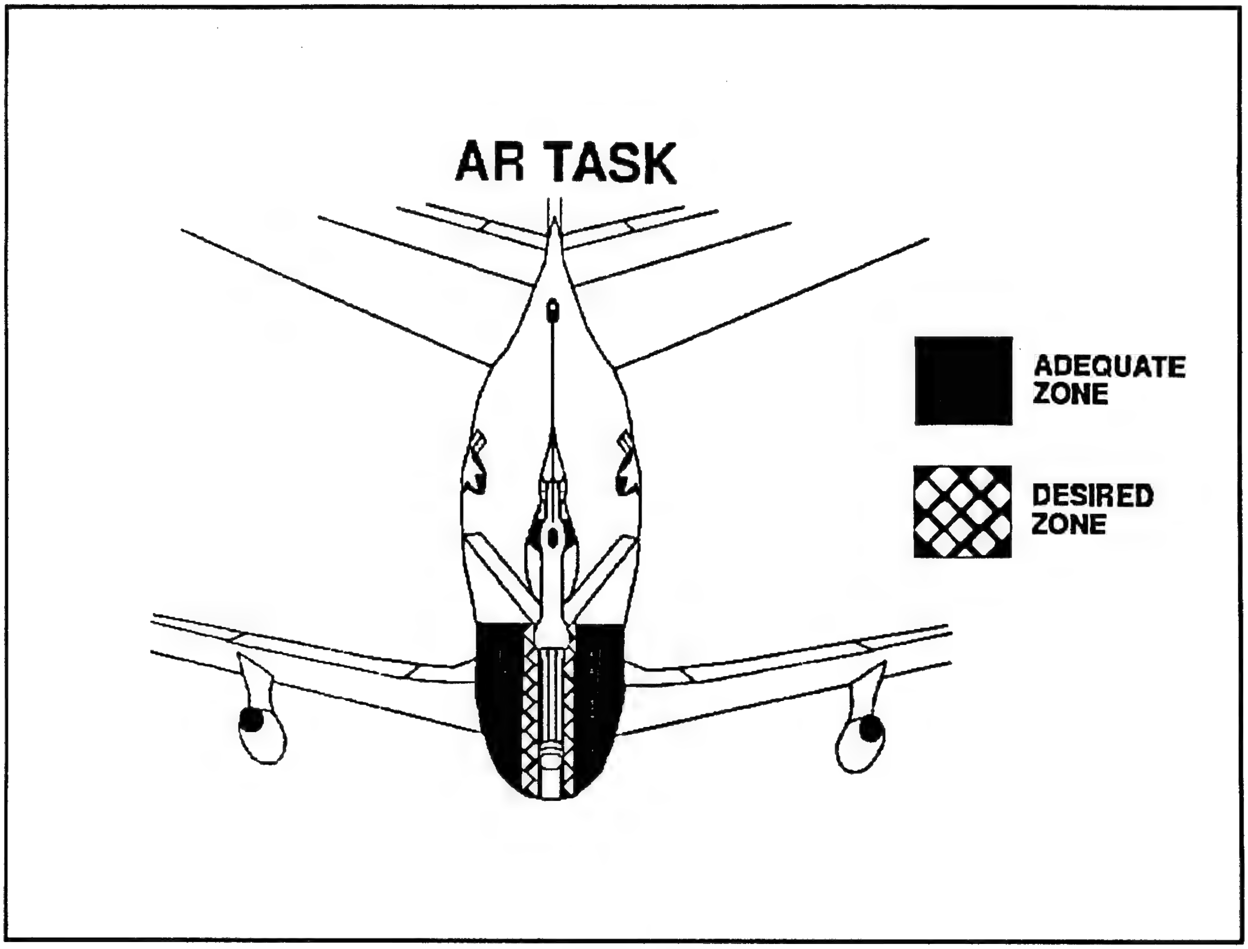

Figure 3.2

Based upon student-designed criteria, give a Cooper-Harper Rating and pilot comments. As a help in designing the task, imaginary rectangles represented by the PDI lights and by the tanker's fuselage between the nose and wing leading edge, may be useful to, in part, define desired and adequate performance criteria (See Figure 3.2). The student test team should further define the task and method used to record pilot performance prior to the mission briefing. Possible criteria involve timing how long the pilot can maintain the desired or adequate position with minimal excursions. Criteria following Figure 3.2 may be used as a guide. (Adopted from "Testing and Verification for Closed Loop Handling Task, Class III-L Aircraft", presented at 1993 SETP symposium by Capt Bruce DeWitt, USAF.)

Desired: Desired zone defined as:
±10 ft fore/aft, ±8 deg up/down, ±3 deg azimuth
Time to remain in zone:
cumulative 60 seconds of the 2:00 minute task

Adequate: Adequate zone is defined as:
±10 ft fore/aft, ±8 deg up/down, ±8 deg azimuth
Time to remain in zone:
Minimum 2:00 minutes

13. Low level/simulated airdrop (500 ft AGL min).
The C-141 will often enter a threat area low level to minimize radar detection. Plan to fly a AFFTC colored low level route. Time spent on the low level will depend on other mission events. Plan to fly 500 ft AGL minimum, 240 kt groundspeed, though local conditions may dictate slightly higher altitude.

Airdrop may be simulated or flown with actual training bundles. Plan for the IP to brief specific procedures depending on mission profile (use of FARM DZ, etc). In general, airdrops are flown from 500-1100 ft AGL, 135-150 KCAS, gear up, flaps set depending on cargo deck angle required for the drop. The pilot maintains the aircraft on a precise run-in heading to a specific computed air release point (CARP) over the drop zone. Adhere to the flight manual limitations in the airdrop configuration (petal doors open): 180 KCAS maximum recommended speed, maximum of 10 degrees sideslip.

14. Trim Shot (15,000 ft, Vapp + 30 kts, PA--Flaps 75%).
Typical downwind/maneuvering speed for C-141 when configured for landing.

15. Steady Heading Sideslips (15,000 ft, Vapp + 30 kts, PA).
Investigate steady heading sideslips (use stabilized or slowly varying method). IP may demo effects of rudder high and low pressure.

CAUTION

USE CAUTION IN RATE OF RUDDER INPUT, ESPECIALLY IN THE RUDDER HIGH PRESSURE MODE. AS A GUIDE, DO NOT EXCEED 15 DEGREES OF SIDESLIP (NOT AN AIRCRAFT LIMIT).

16. Approach to Stall (15,000 ft, 1 g).
Investigate near stall qualities, trimming to 1.4 V_{stall} prior to slowdown. Recovery (release back pressure, add power up to MRT) will be made at actual or computed stick shaker, whichever occurs

first. Minimum altitude 5000 ft AGL. Pay attention to handling qualities when cleaning up the aircraft after this maneuver.

17. Flight Path Stability (11,000 - 9000 ft MSL)--Optional.
Set up at 12,000 ft with gear and flaps 75% (Vomin = Vapp), power set to achieve about 600 ft/min rate of descent and Vapp.

18. Normal Touch and Go/Tactical Approaches.
Perform normal straight in landing to a touch and go. Identify any handling qualities characteristics noted during up-and-away flight.
Tactical approaches consist of steep straight in (see description for vertical offset approach below) or "random steep" spiral maneuvers. The random steep approach is flown from 3000-4000 ft AGL with gear and full flaps. See Starlifter Guide for a more complete description.

19. Offset Landing Task.
The IP will help the students establish an appropriate vertical or horizontal offset condition from which to begin maneuvering back to the normal glidepath/runway centerline. Solicit pilot comments and as an option, develop desired/adequate criteria.

(1) The vertical offset task can be set up by flying a level final approach of 1,000' AGL (PA with Flaps-Approach) until the runway overrun approaches the nose of the C-141. Establish the landing configuration (Flaps-Landing) and begin a descent to recapture the normal glideslope.

(2) The horizontal offset task can be set up by flying a normal glidepath offset 200-300 feet (estimate using the width of the runway as a reference) either direction from the runway centerline. At 300 ft AGL, maneuver back to runway centerline.

(3) The goal of either offset task is to recapture the normal glidepath and runway centerline by 100 ft AGL. A go-around should be made whenever maneuvering has not been completed by 50 ft AGL or directed by the IP.

20. Debrief.
The mission of the C-141 is both strategic and tactical airlift. The students will debrief how well they think the C-141 can perform these missions based on the handling qualities observed. Open loop characteristics may be used to help explain what was seen closed loop. Finally, students should comment on their adaptability to the crew environment and lessons learned.

INSTRUMENTATION:
Data acquisition system, real-time monitoring capability and strip charts. Control forces/deflections should also be estimated. If an instrumented aircraft is not available, hand-held data should be collected. In that event, a hand-held force gauge, tape measure, yaw string, stop watch, sensitive

G-meter or other appropriate device may be used, if desired.

DATA REDUCTION/REQUIRED PLOTS:

Strip charts for debrief.

F-16 AERODYNAMIC MODEL VALIDATION DEMO
(PILOT, FTE/N TM)

REFERENCES:

1. Flying Qualities Textbook, Chapter 22, 23, 24, 25.
2. AFFTC-TLR-91-SO.2

PURPOSE:

1. To demonstrate the flight test techniques used to estimate aerodynamic stability derivatives/frequency response and evaluate handling qualities.

2. To demonstrate the techniques and analysis used to estimate aerodynamic stability derivatives/frequency response and predict handling qualities.

3. To demonstrate control room operations, procedures, and test director responsibilities.

AIRCRAFT:

Two F-16s with DAS (required) and TM (required for TM training only)

LIMITATIONS:

1. No abrupt rudder releases or reversals above 300 KCAS/0.6 Mach (ie, no yaw frequency sweeps).

2. Aircraft will not come closer than 1000 feet to one another during tracking tasks.

3. Aircraft limitations are listed in the F-16 Flight Manual.

GENERAL:

1. This mission has been designed to demonstrate and practice aerodynamic model validation flight test techniques and data analysis. These techniques will enable you to validate a predicted flying qualities model. It is an important step in the "Predict/Test/Validate" process. The handling qualities aero model validation and frequency response simulator sessions should be completed prior to this sortie.

2. Students will be teamed into pilot and FTE/N pairs. Some FTE/Ns may be paired with more

than one pilot.

3. The mission will be telemetered to the USAF TPS control rooms. FTE/Ns will be in the USAF TPS control room to make data quality calls and provide maneuver guidance to the pilot team members. Keep in mind TM is not a go/no-go requirement for model validation, though an instrumented aircraft is.

4. The data bands, tolerances, and maneuver requirements described below have been developed from empirical analysis, and proven to produce the best results.

MISSION EVENTS:

1. Mission Preparation.

Pilot: Responsible, within the constraints of the mission card, to fly an efficient mission profile with specific emphasis on moving expeditiously from point to point on the card. Prepare a data card for the mission. This card will cover the necessary in-flight data. Present a copy of this card to the IP. Plan to record data using the F-16 DAS.

FTE/N: Prepare the control room prior to flight for telemetry.

2. Simulator Sorties (Aero Mod and FRA).

Pilot/FTE/N: Perform practice sorties in the ground simulator under the supervision of an instructor. The emphasis will be on proper flight test techniques, and an introduction to data reduction methods currently available (pEst--parameter estimation and FRA--frequency response analysis).

3. Briefing.

IP: Brief the general and specific mission requirements to include test techniques, formation procedures, limitations and safety.

IFTE/IN: Brief the requirements for each event, data procedures, and control room procedures.

4. Preflight/Ground Operations.

Pilot: Perform a stability and control ground block with telemetry on. Turn on the standby reticle and set depression (suggest 100-150 mils for F-16). Preflight and ground operations will be conducted as a formation flight.

5. Takeoff.

Pilot: At the IP's discretion, an interval/formation takeoff or airborne pickup may be flown.

6. Airborne SI Check.

Pilot: Make control inputs in all three axes to verify proper calibration and operation of instrumentation parameters.

7. Joinup.

Pilot: Target will joinup as soon as possible to route formation.

8. Trim Shot (17,000 ft, 0.58 Mach, CR).

Pilot: Set the barometric reference to 29.92 in Hg. Perform a trim shot at 0.58 Mach, 17,000 ft, cruise configuration. Run DAS to record trim values for later model validation.

This particular test point will illustrate the total process involved in modal validation: handling qualities, stability derivatives, and frequency response estimation.

9. Handling Qualities Investigation. The test aircraft will perform a handling qualities investigation using the Phase 1/Phase 2/Phase 3 approach. Though you will also be collecting data to validate the flying qualities model, it is the handling qualities that are the most important (i.e. pilot comments).

a. Phase 1 (Warmup/Low Gain Tracking):

Pitch/roll steps and steady heading sideslips may be performed as part of low bandwidth HQ maneuvering prior to tracking. After these initial maneuvers, test aircraft should move to a 1,500 foot trail position on target (lead). Use radar to assist in ranging. On test aircraft's call, the target should make approximate 2 g turns. The test aircraft will perform low gain tracking (for example, keep the target in the HUD/gunsight field of view). After one or two minutes, call complete and move ahead to Phase 2 (HQDT) maneuvers.

b. Phase 2: 2g HQDT Tracking Task, Student Practice.

This flight test technique, designed to generate high pilot bandwidth, is called handling qualities during tracking (HQDT). Both qualitative pilot comments regarding handling qualities and data for FRA can be collected using this method.

Pilot: When in position and at the test Mach and altitude, the test aircraft (trailer) will turn on the DAS and HUD camera (optional) and call "test ready." TM will respond "TM ready," when they are ready to record. The target aircraft (lead) will then call "target ready, right (left) turn," once established on the test Mach and altitude. When the test aircraft calls "begin maneuver," the target will begin a 2g (±0.2g), constant Mach number (±0.02), level (±500 feet) turn in the announced direction. The test aircraft will gain enough cutoff to begin a slow

convergence with the target while holding the test conditions ±0.02 Mach number and ±500 feet. The test aircraft pilot will choose a precise aimpoint on the target (ie. canopy, tailpipe, etc.) and aggressively track that point to zero error with reference to the fixed gunsight pipper. Tracking will be accomplished without the use of rudder pedals or trim. The test aircraft pilot will call "tracking," once tracking of the target has been established.

The engineer in the control room will start a 32 second timer on the "tracking" call. The 32 seconds is the minimum time (longer runs are OK) needed for each HQDT run, based on the sampling rate of the instrumentation to get a minimum of 1024 samples for the FRA. At the "run complete" call, the target will roll out of the turn and return to the test conditions. The test aircraft will gain spacing for the next tracking task. The student should practice this maneuver using both left and right turns. At least two good runs are required for post-flight data reduction.

IP: Since the pilot's undivided attention will be devoted to tracking the target, keep the airspeed within tolerances by controlling the throttle or calling out Mach number during the tracking task. Monitor altitude and range to target to ensure it remains within tolerances.

FTE/N: Ensure that you collect enough data from the tracking tasks to satisfy the 1024 data points requirement for the frequency response analysis (32 second minimum--longer is OK). Qualitatively debrief data quality, though it is difficult to judge the bandwidth without a power spectral density (PSD) plot.

c. Phase 3 (Operational Handling):

Set up for this task from either the abeam or "perch" position at approximately 1500 ft from the target. On the test aircraft's "ready" call, the target should begin a 2 g turn away from the test aircraft. Acquire and track the target using "operational" gains. The target may reverse as requested by lead. Rate the handling qualities with the Cooper-Harper scale based on the following criteria:

PERFORMANCE LEVEL	GROSS ACQUISITION	FINE TRACKING
Desired	tailpipe within 25 mil circle with maximum of 1 overshoot	pipper on canopy for 3 seconds
Adequate	tailpipe within 50 mil circle with maximum of 1 overshoot	pipper on fuselage for 1 second

Repeat the task at least once prior to lead change.

10. Lead Change. (if applicable)
Pilot: After the "run complete" call from the last tracking task, swap leads. After the lead change, the new test aircraft will practice the HQ investigation. Once complete, split the flight into two single ships, each with TM.

11. Stability Derivative Estimation.

A. 1g Pitch Doublet, (17,000 ft, 0.58 Mach, CR) IP Demo.

IP: Turn on DAS and HUD camera (optional) and call "test ready." The trim data band is ±0.02 Mach and ±500 feet. TM will respond "TM ready," when they are ready to record. The purpose of the upcoming doublets is to collect data for estimating aero stability derivatives. In general, this FTT is a rapid pitch doublet followed by a period of stick fixed oscillation. For an irreversible system, the flight controls may be released following the doublet. The doublet should be accomplished as a sharp, impulse input in each direction. The entire doublet should be completed in approximately 1 second. Adjust the magnitude of the aft and forward stick inputs to obtain symmetrical aircraft responses. The AOA should vary less than ±2 degrees from the trim AOA, so that non-linearities caused by large AOA changes do not occur. At the initiation of the doublet call "ready, ready, mark" and approximately 3 seconds after the end of the doublet call "complete". As a technique do a series of three doublets, then wait for TM critique.

IFTE/IN: After each doublet, TM will provide a critique of the maneuver. The most important characteristics are sharp inputs which produce symmetrical aircraft responses with approximately ±10 degrees per second pitch rate and less than ±2 degrees AOA change from trim AOA. Critique the maneuvers and provide feedback to the IP make your feedback directive in.

B. 1g Pitch Doublet, Student Practice.

Pilot: Perform pitch doublets until you get a good set of three.

FTE/N: Critique the maneuvers and provide feedback to the pilot.

C. 1g Yaw-Roll Doublet, IP Demo.

IP: Turn on DAS and HUD camera and call "test ready." TM will respond "TM ready," when they are ready to record. This FTT is a rapid yaw doublet followed by a period of stick/rudder

fixed oscillation and a rapid roll doublet. Each doublet should be accomplished in approximately 1 second, with a an appropriate spacing in between the doublets. The yaw/roll doublets are accomplished as a set--let the motion subside between the yaw and the roll doublet, but allow no more than about 2 cycles. Adjust the magnitude of the control inputs to obtain symmetrical aircraft responses. At the initiation of the yaw doublet call "ready, ready, mark" and at the end of the roll doublet call "complete".

After each yaw-roll doublet, TM will provide a critique of the maneuver. The most important characteristics are inputs which produce symmetrical aircraft responses with less than ±2 degrees AOS change. The data band is ±0.02 Mach and ±500 feet.

IFTE/IN: Critique the maneuvers and provide feedback to the IP.
Look for approximately ±5 to 10 degrees per second yaw rate, ±20 degrees per second roll rate.

D. 1g Yaw-Roll Doublet, Student Practice.

Pilot: Perform yaw-roll doublets until you get a good set of three.

FTE/N: Critique the maneuvers and provide feedback to the pilot.

E. 2g Pitch Doublet, Student Practice.

These doublets will be used to estimate stability derivatives at elevated g/alpha.
Pilot: Stabilize the aircraft in a 2g level turn at 0.58 Mach and 17,000 feet. The FTT is performed in the same manner as at 1g. You may practice these doublets with and without trim. Realize that for higher g loadings, you may run out of trim authority and have to depend on a “no trim” technique. The data band is ±0.02 Mach, ±500 feet, and ±0.2g at initiation of the doublet.

FTE/N: Critique the maneuvers and provide feedback to the pilot.

F. 2g Yaw-Roll Doublet, Student Practice.

Pilot: Stabilize the aircraft in a 2g level turn at 0.58 Mach and 17,000 feet. The FTT is performed in the same manner as at 1g. The data band is ±0.02 Mach, ±500 feet, and ±0.2g at initiation of the doublet. FTE/N: Critique the maneuvers and provide feedback to the pilot.

12. Frequency Response Estimation.

The following sweeps are used for frequency response estimation and can augment the information collected during Phase 2 HQ testing.

A. Pitch Frequency Sweep, IP Demo.

IP: Turn on DAS and HUD camera (optional) and call "test ready." TM will respond "TM

ready," when they are ready to record. This FTT is a slowly increasing frequency pitch sweep (usually accomplished as a "programmed test input"--or PTI--by the flight control system). For these type of manual sweeps, start with a slow, smooth push forward. As a technique, this first stick input should last approximately 5-7 seconds. Reverse the stick and slowly pull the stick back increasing the rate of stick movement (about 1 second faster between each forward and aft cycle). Continue to reverse the inputs and increase their frequency until the aircraft does not respond. The maneuver should be planned to reach saturation at a minimum of 32 seconds (instrumentation dependent, and as in the HQDT runs, a longer time is OK). The AOA should vary less than ±2 degrees from the trim AOA during the sweep. At the initiation of the sweep call "ready, ready, mark" and at the end of stick movement call "complete". During the sweep, stick force should increase to maintain approximately the same amount of aircraft response throughout the maneuver. After the sweep, TM will provide a critique of the maneuver. The data band is ±0.02 Mach and ±500 feet.

IFTE/IN: Call out elapsed time every 5 seconds or as requested by the test aircraft. Critique the maneuvers and provide feedback to the IP.

B. Pitch Frequency Sweep, Student Practice.

Pilot: Perform pitch frequency sweep until you have one good run.

FTE/N: Call out elapsed time. Critique the maneuvers and provide feedback to the pilot.

C. Roll Frequency Sweep, IP Demo.

IP: Turn on DAS and HUD camera (optional) and call "test ready." TM will respond "TM ready," when they are ready to record. Start the sweep with a slow, smooth left stick input. As with the manual pitch sweep, this first stick input should last approximately 5-7 seconds. Reverse the stick and slowly pull the stick to the right increasing the rate of stick movement from the first input. Continue to reverse the inputs and increase their frequency until the aircraft does not respond. The maneuver should be planned to reach saturation at the 32 second point. The AOS should vary less than ±2 degrees during the sweep. At the initiation of the sweep call "ready, ready, mark" and at the end of stick movement call "complete". During the sweep, stick force/deflection should increase to maintain approximately the same amount of aircraft response throughout the maneuver. After the sweep, TM will provide a critique of the maneuver. The data band is ±0.02 Mach and ±500 feet.

IFTE/IN: Call out elapsed time. Critique the maneuvers and provide feedback to the IP.

D. Roll Frequency Sweep, Student Practice.

Pilot: Perform roll frequency sweep until you have one good run.

FTE/N: Call out elapsed time. Critique the maneuvers and provide feedback to the pilot.

E. Yaw Frequency Sweep, IP Demo.

IP: Turn on DAS and HUD camera (optional) and call "test ready." TM will respond "TM ready," when they are ready to record. Start the sweep with a slow, smooth left rudder input. As before the first rudder input should last about 5-7 seconds. Reverse the rudder and slowly push the rudder to the right increasing the rate of rudder movement from the first input. Continue to reverse the inputs and increase their frequency until the aircraft does not respond. The maneuver should be planned to reach saturation at the 32 second point. The AOS should vary less than ±2 degrees during the sweep. At the initiation of the sweep call "ready, ready, mark" and at the end of rudder movement call "complete". During the sweep, rudder force/deflection should increase to maintain approximately the same amount of aircraft response throughout the maneuver. After the sweep, TM will provide a critique of the maneuver. The data band is ±0.02 Mach and ±500 feet.

IFTE/IN: Call out elapsed time. Critique the maneuvers and provide feedback to the IP.

F. Yaw Frequency Sweep, Student Practice.

Pilot: Perform yaw frequency sweep until you have one good run.

FTE/N: Call out elapsed time. Critique the maneuvers and provide feedback to the pilot.

13. Land.

Pilot: Perform a normal landing.

14. Debriefing.

a. Pilot/FTE/N: Debrief IP/IFTE/IN on quality of data and handling qualities at the test conditions.

b. IP/IFTE/IN: Debrief on mission planning, FTT performance, test team coordination, and quality of data.

INSTRUMENTATION:

Collect data with the F-16 DAS, TM recorders, and stripcharts.

DATA REDUCTION/REQUIRED PLOTS:

Much of the data quality will be determined after the data reduction. A post-flight data reduction lab will be scheduled with all students. Typical quantitative data includes estimated stability derivatives (such as Cm_α, Cn_β, etc.), open loop transfer functions (such as q/δ_e), and closed loop transfer functions (such as q/F_s for Rsmith criteria). Compare HQ predictions to actual CH ratings.

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T-38 AERODYNAMIC MODEL VALIDATION DATA (P/FTE/N)

REFERENCES:

1. Flying Qualities Textbook, Chapter 21-25.
2. AFFTC-TLR-91-SO.2

PURPOSE:

1. To practice the flight test techniques used to estimate stability derivatives, frequency response, and evaluate handling qualities.

AIRCRAFT:

T-38 with DAS (required), gun sight (desired), and suitable target (required)

LIMITATIONS:

1. Aircraft will not come closer than 1,000 feet to one another during tracking tasks.

2. Aircraft limitations are listed in the T-38 flight manual.

GENERAL:

1. As in the previous model validation sortie in the F-16, this mission has been designed to practice aero model validation flight test techniques, this time with the more conventional flight control system of the T-38 and in a crew solo environment. The F-16 Aerodynamic Model Validation sortie should be completed prior to this sortie.

2. Students will be teamed into pilot and FTE/N pairs.

3. The data bands, tolerances, and maneuver requirements described below have been developed from empirical analysis of historical results, and proven to produce the best results.

MISSION EVENTS:

In general, the mission events, FTTs, and tolerances are the same as in the F-16 sortie. Exceptions are noted below.

1. Mission Preparation.
Same as F-16 sortie, although the student team will brief and be responsible for the mission

conduct. No TM is planned for this sortie.

2. Briefing.
Students will conduct the briefing, including general and specific mission requirements and coordination with the target aircraft (IP in the target).

3. Preflight/Ground Operations.
Pilot: As with the previous sortie, perform a stability and control ground block with the DAS on. Turn on the gunsight and set depression (suggest 100-150 mils for T-38). If no gunsight is installed, draw a suitable substitute on the glareshield, centered near the tip of the pitot boom. Preflight and ground operations will be conducted as a formation flight.

4. Takeoff.
As before, at the IP's discretion, an interval takeoff or airborne pickup may be flown.

5. Trim Shot (20,000 ft, 0.70 Mach, CR).
Pilot: Set the barometric reference to 29.92 in Hg. Perform a trim shot at 0.70 Mach, 20,000 ft, cruise configuration. Run DAS to record trim values for later model validation.

6. Handling Qualities Investigation. The test aircraft will perform a handling qualities investigation similar to that performed in the F-16 on the previous model validation sortie. A progressive buildup from Phase 1 to Phase 2 (HQDT) to Phase 3 (Operational Handling) will be flown. Use the same criteria and procedures for this investigation as in the F-16 (see Aero Model Validation Sortie). Use 32 seconds as the minimum run time for record HQDT (again, longer runs are OK). Be aware of closure rates and wake turbulence from the target.

7. Pitch/Roll/Yaw Frequency Sweeps, Student Practice.
Techniques for the manual frequency sweeps are similar, though the center stick/conventional flight control system of the T-38 may require some practice to achieve good data. As with the F-16, a minimum of 32 seconds is needed for the FRA.

8. Pitch/Yaw-Roll Doublets, IP Demo/Student Practice (Optional).
If time/fuel permit, doublets for estimating stability derivatives may be performed at 1 and 2 g. Techniques and tolerances are similar to the F-16, though the center stick/conventional flight control system of the T-38 may require some practice to achieve good data.

9. Land.
Pilot: Perform a normal landing.

10. Debriefing.

a. Debrief on mission planning, FTT performance, test team coordination, and quality of data.

INSTRUMENTATION:

Collect data with the T-38 DAS.

DATA REDUCTION/REQUIRED PLOTS:

As in the previous sortie, much of the data quality will be determined after the data reduction. Post-flight data reduction will be completed by the staff/contractor and given to the students for debriefing in class.

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GLIDER FLYING QUALITIES DEMONSTRATION (P/FTE/N)

REFERENCES:

1. USAF TPS High L/D Course Handout
2. USAF TPS Sailplane Aircrew Aid
3. "The Joy of Soaring," Carle Conway
4. "Soaring Flight Manual," Soaring Society of America
5. FAR, Parts 61 and 91

PURPOSE:

1. To expose students to more aircraft.

2. To increase student familiarization with glider flying prior to spin indoctrination.

3. To demonstrate flying qualities of the Grob 103 and ASK 21.

4. To introduce qualitative evaluation in a "new" aircraft.

AIRCRAFT:

1. Grob 103 and ASK 21.

2. Backup aircraft as specified in the soaring contract or operationally available with contractor and chief soaring instructor approval.

LIMITATIONS:

1. FAR, Parts 61 and 91.

2. Contractor local operating procedures.

3. Stalls should be fully recovered by 1500 feet AGL.

GENERAL:

1. FTE/Ns may ride in the front seat.

2. While there is no requirement for flying proficiency in any maneuver, FTE/Ns are encouraged to attempt maneuvers when no conflict with the lessons desired learning objective is encountered (CFI-G on board required).

3. The order in which the aircraft are flown is optional.

4. Events will be flown at the applicable maximum L/D airspeed for the aircraft being flown.

PROCEDURES:

1. Preparation and Preflight.

The general soaring information (glider operations, traffic patterns, etc.) can be found in the references for this mission. The student should have a mission card prepared with the events and the desired data clearly annotated. The events covered in this profile provide interesting comparisons, but additional flying qualities FTTs can be added with the prior approval of the instructor. On preflight, pay particular attention to the following items:

a. Cockpit design and layout,
b. Pitot static system sources,
c. Fuselage side area distribution,
d. Differential aileron travel,
e. Wing design,
f. Horizontal tail design and location,
g. Pitch trim location and operation,
h. Vertical tail size and moment arm, and
I. Rudder size and hinge design.

2. Takeoff and Aerotow (3000' AGL).

Use caution during initial rotation for pitch sensitivity. Box the wash noting control power and harmony, and overall handling qualities. Additionally, put the "T" tail in the propwash, with the aircraft below the propwash, and note the resulting pitch handling characteristics.

3. Lateral-Directional.

Perform a coordinated shallow and steep banked turns noting coordination cues (yaw string and side forces). Check spiral stability by stabilizing in a steep banked turn, at minimum sink airspeed, and noting the aileron position and forces. Do not allow the airspeed to increase. This technique must be used because glider spiral stability is not apparent using the normal spiral FTT and mil spec parameters. However, in the glider operational envelope (thermalling), spiral instability is a definite factor. Next, perform a spiral turn by starting from the steep banked turn and then slowly increasing bank and back pressure while allowing the nose to fall below the horizon. Spiral recoveries can only be made by relaxing back stick pressure and shallowing the bank to less than 45 degrees, then gradually increasing back stick pressure while rolling out

of the turn. DO NOT over stress or over speed the aircraft! Perform full deflection aileron rolls (30 degrees to 30 degrees) with rudder free and with coordinated rudder. Perform full rudder deflection steady heading sideslips using outside references (the gliders do not have heading systems). Observe forces, deflections, pitot static errors, rate of descent and approximate sideslip angles. Watch for rudder lock during the roll performance and sideslips.

4. Stalls.

Perform a phase A stall with a one knot/second bleed rate and phase B stalls with one and five knot/second bleed rates. Note flying qualities approaching the stalls, the stall characteristics, spin susceptibility and control effectiveness during recovery. Use rudder to raise a wing if one drops. Ailerons should be neutral during the stall and during the recovery until flying airspeed is regained. With the ailerons deflected at stall there is sufficient adverse yaw to cause a spin.

5. Dynamics.

Examine dutch roll response with both rudder and aileron doublets. Note the damping and roll/yaw ratios. Examine the phugoid mode by slowly decreasing airspeed ten knots from the trim airspeed (maximum L/D) and release the stick. Use rudder, and if necessary very light aileron force, to hold the wings level. Note the static stability, the phugoid period and whether the long period is stable or not. Evaluate pitch trim changes with spoiler deflections.

6. Thermalling Demo.

IP demo thermal soaring techniques if lift is present.

7. Pattern and Landing.

Pick a specific aimpoint and follow it during final approach. Note handling qualities and the ease or difficulty of maintaining the desired pattern airspeed down to the flare. Flare (DO NOT round out or flare high) and hold the aircraft just above the runway. Continue to increase the pitch attitude until the aircraft settles to the runway in a two point landing (main and tail wheels). Note PIO tendencies, directional control (in the air and on the ground) and use small spoiler inputs on flare.

INSTRUMENTATION:

All data are hand held collected data and pilot comments.

DATA REDUCTION:

None.

REQUIRED PLOTS:

None.

OPERATIONAL HANDLING DEMO (PILOT)

REFERENCES:

1. Talon Guide
2. NASA TN D-5153
3. FQ Text Chapter 22

PURPOSE:

1. Demonstrate Air-to-Air operational handling tasks (Phase 3).

2. Demonstrate Air-to-Ground operational handling tasks (Phase 3).

3. Demonstrate use of Pilot Rating Scales and pilot qualitative comments to evaluate closed loop handling qualities for mission suitability.

AIRCRAFT:

Two T-38's (gunfights desired)

LIMITATIONS:

1. As listed in the Flight Manual, in particular unsymmetric G limits.
2. Aircraft will not come closer than 1,000 ft to one another during the tracking task.

GENERAL:

1. This sortie will be a review of some items from the Handling Qualities Demo with emphasis on Phase 3 (Ops Handling Techniques). To aid in obtaining qualitative comments, selected pilot comment sheets are included in Chap 22 of the Flying Qualities Textbook and should be used on this ride as well.

2. The crews will operate for the first portion of the mission as a formation flight. After the Air-to-Air operational handling tasks are completed the formation will split into two single ships. Formation takeoffs and landings may be made with current and qualified IPs. Instructors current in formation takeoff and landings may demo the maneuver. The Talon Guide will be used as a reference for formation position procedures.

3. The aircraft will be evaluated as a replacement multi-role fighter with an Air-to-Air and Air-to-Ground mission.

4. The test team should use a build-up approach when performing operational handling (Phase 3) tasks. Even though previous testing (Phase 1 and 2) may have uncovered handling qualities

characteristics, the best approach when designing and executing a task for the first time involves a gradual "ramp up" of pilot gain. This may be achieved in the task set up or in the desired/adequate criteria themselves. For example, an offset approach may be tried first from 100 ft offset at a maneuver altitude of 400 ft AGL. Next the test team may try varying the maneuver altitude and/or offset from the runway, until the right amount of pilot gain is achieved. By tightening the tolerances for desired and adequate performance, the test team may be able to affect the pilot's workload in a similar fashion. In short, designing good handling qualities tasks cannot be done in a vacuum, and requires the full effort and insight of the entire test team.

MISSION EVENTS:

1. Mission Preparation.

Pilot: Responsible, within the constraints of the mission card, for planning and flying an efficient mission profile. Obtain a Cooper-Harper Rating Scale Card and PIO Rating Scale for in-flight use. Prepare a data card. Present a copy of the card to the Instructor Pilot. Plan to record data using a standard T-38 DAS. If no gunsight is installed, prepare a simulated pipper and 25 and 50 mil reticle using a one inch and two inch diameter oval on acetate or plan to draw circles on the T-38 windscreen. The oval reticle should be centered on the horizon while on the ground.

2. Brief.

IP: Brief the entire mission with emphasis on attitude flying, unusual attitudes, tracking techniques, operational handling task development, Rules of Engagements (ROE), recoveries and unsymmetric G limitations.

3. Preflight/Ground Ops.

Preflight and ground operations will be conducted as a formation flight.

4. Takeoff.

At the discretion of the instructor, the takeoff will either be an instructor demo'd formation takeoff, or a max power student performed single ship takeoff using 8 seconds spacing.

5. Joinup.

Wingman will rejoin as expeditiously as possible to close formation.

6. Formation.

Perform operationally representative maneuvers (e.g. close formation, cross-unders, a pitchout/rejoin, and tactical formation) and make qualitative comments concerning the aircraft response, control forces, pilot workload and type of compensation (if any) required. Swap leads and repeat the maneuvers for number 2.

7. Operational Handling Task. IP Demo Air-to-Air Tracking.

Conditions: 15,000 (±1000) ft MSL, 350 (±10) KIAS co-speed, 2000 ft line abreast. Call "Target Ready", "Fighter Ready, Begin Maneuver."

Tracking Tasks: At Begin Maneuver call, the target enters a 3 G (±0.2) turn away from the fighter. The fighter accomplishes a gross acquisition task of aggressively bringing the pipper to the target tailpipe using 4 Gs simulating an AIM 9 air-to-air missile shot. The maneuver is continued and the fighter closes to 1200-1500 foot range and begins a fine tracking task of holding the pipper on the target canopy simulating a guns tracking solution. The IP can help adjust the power to obtain a reasonable closure rate, however this may invalidate the pilot's workload assessment. The maneuver will be terminated at no less than 1,000 feet slant range. At 1,000 feet most of the details such as tail numbers, figure 8 on tailpipes, and separate canopies are easy to see. Handling Qualities Ratings using the Cooper-Harper and PIO rating scales will be given for each task based on the following criteria:

PERFORMANCE LEVEL	GROSS ACQUISITION	FINE TRACKING
Desired	tailpipe within 25 mil circle with maximum of 1 overshoot	pipper on canopy for 3 seconds
Adequate	tailpipe within 50 mil circle with maximum of 1 overshoot	pipper on fuselage for 1 second

Unlike HQDT, during this task the pilot is not expected to track to zero error. Inputs during operational handling (Phase 3) maneuvers are typically smoother and at a lower bandwidth than those involving HQDT (Phase 2). During these maneuvers, it is critical the pilot monitors his/her compensation necessary to complete the task. According to Cooper and Harper, "The pilot should report on what he sees and feels, and describe his difficulties in carrying out

whatever he is attempting." As a guide in structuring your qualitative comments, keep in mind your workload, the aircraft forces and response while executing the task.
If time and fuel permit, students may vary the initial set up to vary the pilot's workload for gross acquisition (for example, having the target turn <u>into</u> the fighter, or using a "perch" set up vs line abreast).

8. <u>Operational Handling Task - Student Practice Air-to-Air Tracking.</u>
Student repeats IP demo tracking task.

9. <u>Swap leads and repeat the Demo and Student Practice Air-to-Air Tracking.</u>
Following this, split the formation into two single ships.

10. <u>Air-to-Ground Ops Handling.</u>
The IP will demonstrate (if necessary) and the pilot will practice Air-to-Ground re-position tasks and simulated Air-to-Ground weapons deliveries. The student should qualitatively evaluate the ability of the aircraft to perform these operational tasks. Set up at a minimum altitude of 10,000 ft <u>AGL</u> and 350 KIAS. Simulated release parameters are 450 KIAS at 5000 ft <u>AGL</u>. Recover using 4Gs in 2 seconds until the nose is above the horizon. Minimum altitude is 3000 ft <u>AGL</u>.

a. Re-position tasks are performed using the 25 mil reticle used in the Air-to-Air handling tasks (centered near the roll axis of the aircraft to minimize pendulum effects--approximately at the base of the magnetic compass) and to evaluate the ability of the aircraft to acquire new aim-off points. Roll into a 30° dive and aggressively pull the pipper to the target. Once established, aggressively reposition the pipper on a new target offset approximately 25 mils longitudinally from the original target. Next, aggressively reposition the pipper on a new target offset approximately 25 mils laterally from the target. The longitudinal and lateral repositions may need to be accomplished on separate passes. If time permits, repeat with the yaw damper off.

b. (Optional) Simulated Air-to-Ground weapons deliveries are performed by using the student-drawn pipper as the aircraft flight path marker and the base of the pitot tube as the depressed pipper. Roll into a 30° dive and place the flight path marker (pipper) on your aim off distance point (approximately 2800 ft beyond the target). Hold the aim-off distance steady and allow the depressed bomb pipper (the base of the unpainted part of the pitot tube) to track to the target. Correct as necessary for aiming errors and winds.

c. (Optional) A pop-up bombing pattern may be demonstrated to familiarize the student with an ingress to a target area which would typically be flown by tactical air-to-ground units.

Note: The pop-up pattern must be demonstrated if the student will be performing them in data group aircraft.

The intent of the pattern is to fly to the target area at low altitude, high speed; then pull up to visually acquire the target; then roll in to perform a dive bomb delivery. There are many variations, but this demo pattern will provide an example of a low altitude ingress to a target, followed by a 20 degree visual bomb delivery. This event will provide an opportunity for qualitative assessments of flying qualities during an operational representative, high workload, time-compressed task. TPS Air-to-Ground Rules of Engagement will be briefed prior to flying this maneuver. A minimum airspeed of 300 KIAS will be used. The following planning information is provided (IP will provide examples of pop-up patterns to specific targets):

1) 500 ft AGL run-in.

2) 420 kts ground speed (approx 400 KIAS, 4000 ft MSL, std day, no wind).

3) Initial heading direct to target.

4) 30 degree heading change at 4 NM from target (the 4 NM action point identified by timing or preplanned visual reference).

5) Time 10 seconds after action point.

6) Pull up 30 degrees, Mil power.

7) Begin pull-down (i.e. roll-in) at 3,400 ft AGL.

8) Adjust pull-down aggressiveness to Apex at 4,900 ft AGL.

9) Complete roll-in with proper aiming on target.

10) Simulate weapon release at 2,500 ft AGL, 450 KIAS.

11) Recover with 4 g pull off.

Figure 3.3 gives a graphic depiction of the final run-in pattern.

11. <u>Offset Landing</u>.

a. Pilot: Perform a lateral offset landing task for operational suitability analysis using the following conditions:

Final approach positioning: On VASI or ILS glideslope, offset to either edge of the concrete runway (150 ft), on speed, above 400 ft AGL.

Offset Correction: At 2,500 ft MSL (200 ft AGL) correct to land on centerline at a predetermined touchdown distance (based on the chosen aim point, no less than 1000 ft from approach end). Do not attempt an offset landing if you inadvertently descend below 200 feet AGL before beginning the maneuver. Accept a long landing if the predetermined touchdown point cannot

be achieved safely.

b. After landing roll out and clear of the runway, or in a safe position in the traffic pattern, assign a Cooper-Harper Rating and a PIO Rating for the landing task using the following performance criteria:

Desired: -Airspeed at touchdown - V_{aim} $\pm$5 KIAS
- $\pm$200 ft of predetermined touchdown point
-Within wingtip spread of centerline

Adequate: -Airspeed at touchdown - V_{aim} +10/-5 KIAS
-$\pm$500 ft of predetermined touchdown point
-Aircraft within 50 ft of centerline

When using desired/adequate criteria with more than 1 requirement/group, (ie, offset approach has airspeed, longitudinal and lateral spacing for desired/adequate performance), the test team should decide on how any "loopholes" will be assessed. For example, if the pilot lands on-speed, 300 feet long, and within a wingtip spread on the above task, is that desired or adequate performance?

12. Spot Landing. (Optional)
Pilot: If fuel permits perform a spot landing. Qualitatively evaluate aircraft response, control forces, pilot workload and type of compensation (if any) used.

13. Debrief.

a. Pilot: Debrief the IP on aircraft handling qualities during all operational tasks evaluated. Discuss impacts on operational suitability of aircraft.

b. IP: Debrief on mission planning, task performance, and quality of comments.

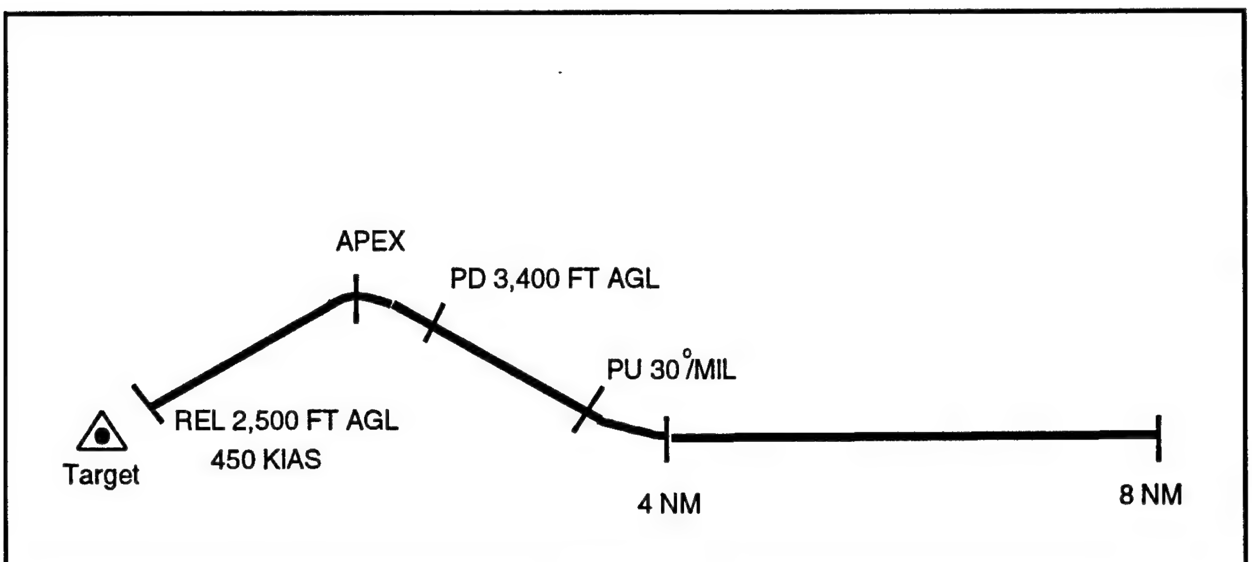

Figure 3.3

INSTRUMENTATION:

None required. The Cooper-Harper Rating Scale and PIO Rating Scale should be used and qualitative comments will be made.

DATA REDUCTION/REQUIRED PLOTS:

None.

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FLYING QUALITIES CHECK FLIGHT PRACTICE (PILOT)

REFERENCES:

1. Flying Qualities Phase Textbooks.
2. Flying Qualities Phase Planning Guide.

PURPOSE:

To practice various flight test techniques and validate planned profile in preparation for the Flying Qualities Final check ride. Each pilot will receive one front seat sortie.

AIRCRAFT:

T-38 or C-23A

LIMITATIONS:

As per the flight manual, the Flying Qualities Phase Planning Guide, and appropriate safety limitations (see Appendix B).

MISSION EVENTS:

The student test pilot will plan and fly a practice mission that may include any flight test technique previously demonstrated as part of the curriculum. The flight card will be approved by a TPS graduate IP in the aircraft.

INSTRUMENTATION/DATA REDUCTION/REQUIRED PLOTS:

None.

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FLYING QUALITIES CHECK FLIGHT (P/FTE/N)

REFERENCES:

1. Flying Qualities Textbook, Chaps 30 & 33
2. MIL-STD-1797A

PURPOSE:

1. To integrate the academics and flight test techniques learned and practiced in the Flying Qualities Phase into a comprehensive flying exercise.

2. To allow the student to demonstrate the ability to organize, plan, brief, and fly/direct a test mission assessing the overall flying qualities of an aircraft.

3. Based on this assessment of flying qualities, to determine the overall mission suitability of an aircraft for a given mission.

AIRCRAFT:

T-38A/B (F-69 simulant)

LIMITATIONS:

1. See Appendix B, all performance and flying qualities test plan limits and flight manual limits apply. Maneuvers will be flown according to the techniques previously demonstrated.

2. T-38 specific limits:
   6g or moderate buffet
   20° bank during steady heading sideslips in PA configuration

MISSION EVENTS:

Scenario:

The Fly-By-Night Aircraft Company (FLACO) is independently developing a variant of its F-69B, which is currently operational. At the same time, Air Combat Command is setting up a lead-in fighter (LIF) training program (assume the USAF current program does not exist). An aircraft has not yet been chosen for the program. Through various sources, information has become available to the Air Staff that the F-69B variant may be able to provide the necessary

training at a considerable cost savings from operational aircraft. FLACO is, of course, more than willing to sell the Air Force as many of the aircraft as they can, and hence is perfectly happy to let us fly them. However, because they are still in the early stages of development, FLACO wants to limit the amount of time the Air Force will have to evaluate the aircraft. HQ USAF and FLACO have agreed to a one-sortie evaluation. Basically, HQ AFMC wants to know if it should commit to a full DT&E program.

Facts of life: T-38 aircraft currently available to the Test Pilot School will represent the F-69B (assume the T-38 is not a currently operational aircraft). Each individual will have one flight to gather data in order to recommend whether DT&E is warranted. Assume you will be held accountable for your recommendation to the Chief of Staff. He doesn't want to pass up a chance to acquire an acceptable airplane at a reasonable cost. On the other hand, he doesn't want to risk another multi-million dollar DT&E program on a lemon. In other words, be able logically to justify your conclusions and recommendations based on your results, and make sure the results come from tests that make sense.

Rules of engagement:

A. Before flying, define specific test objectives, test points, and handling qualities tasks. Develop an efficient test sequence that is practical and flexible. Prepare data cards for you, the IP, and the ops desk. Brief the mission using the general and specific mission briefing guides. It's up to you to decide how much of the profile should be devoted to handling qualities (Phase 1, 2, and 3), how much to MIL STD compliance, etc. Each sortie will be planned as a two-ship, with each T-38 providing target support for the other aircraft.

B. During the flight, you'll act as test pilot/director. As such, you will be expected to have a full knowledge of the flight test techniques, collect or arrange for collection of all relevant data, and take deliberate actions to control the flight to meet all objectives.

C. Plan to launch as a two ship formation of T-38s, with each aircraft providing target support for the other. In the event another T-38 is not available as target, another suitable target such as a F-16 may be used (keep in mind the aircraft differences when planning your profile).

D. Total flight time, including target support for the other aircraft, should not exceed 1.5 hrs or normal landing fuel, whichever comes first. Coordinate with your target to use the

time most efficiently.

E. Prepare data cards for yourself, the IP, evaluator, and target aircraft. Determine reasonable data band and tolerances for all handling quality maneuvers. Data bands and tolerances for any MIL STD compliance maneuvers you may care to perform are listed at the beginning of Section III. Include task definitions and criteria for all Phase 3 maneuvers. At least one Phase 3 maneuver should require use of the Cooper Harper rating scale. The IP may be used to help record any data you collect.

F. You may deem it necessary to change test conditions due to weather, turbulence, etc. Coordinate with the IP, but as long as you can meet your test objectives, you should have the flexibility to do what you feel is important.

G. After the flight, you will have one hour to collect your thoughts and any relevant data to debrief the IP (ACC simulant) on your findings, conclusions, and recommendations. Be prepared to discuss the quality of test maneuvers, quality of data obtained, and explain the reasons for in-flight decisions which may have changed your preplanned test sequence. Some of the hand held data may be reduced and presented at this debrief but you are limited to 1 hour of preparation time. The debrief will last no more than 1 hour.

Grading: Your IP will grade the following areas on the flight:

Mission Preparation	20%
Mission Briefing	20%
Data Cards	10%
Airborne Conduct	30%
resource management	
in-flight decisions	
flight performance	
Post Flight Debrief/Conclusions & Recommendations	20%

Helpful hints: Depending on your background, you may or may not have a good handle on the intended mission. The following information should help in setting up a good one flight test plan:

A. DOD is considering purchase of approximately 100 F-69B variants as a relatively inexpensive aircraft capable of providing realistic lead-in fighter (LIF) training.

B. ACC desires to conduct a lead-in fighter training program for pilots transitioning into tactical fighter aircraft from other types of aircraft, nonflying assignments, or undergraduate pilot training (UPT). The program is intended to evaluate a pilot's adaptability for flying tactical fighter aircraft and teach basic fighter pilot skills such as tactical formation flying, aerial combat maneuvers and tactics, and weapons delivery techniques and procedures.

C. Tactical formation flying is planned to include line abreast formation, delayed 90 and 45 degree turns, in place turns, and cross turns at both medium and low altitude.

D. Aerial combat training is planned to include offensive and counter-offensive basic fighter maneuvers (BFM) from controlled set-ups (advanced re-joins).

E. Weapons delivery training is planned for events as specified in current ACC/AETC ops documents. Box patterns will be emphasized, although pop-up deliveries will be taught as well.

F. This evaluation should assess the overall flying qualities of the aircraft and the impact of these flying qualities on the ability to perform the LIF mission.

G. For purposes of MIL STD 1797A, the F-69B should be considered a trainer for Class IV aircraft.

H. Any performance data that can be obtained without interfering with F above would be helpful in spot checking contractor data.

I. Review Chaps 30 and 33 in the Flying Qualities Text for guidance on building a suitable profile.

Despite appearances, the staff really is here to help, if you don't understand something, ask right away.

Keep in mind the emphasis for the flight should be on suitable handling qualities for the mission.

INSTRUMENTATION:
All quantitative data will be acquired using hand held techniques. This implies using a force gauge, tape measure and/or stopwatch, where applicable. Tape recorders are recommended for documenting qualitative data. Task ratings (Cooper Harper scale preferred) should be solicited for well defined tasks.

ENGINE-OUT DEMO/DATA (P/FTE/N)

REFERENCES:

1. Flying Qualities Textbook, Chapter 32
2. MIL-STD-1797A
3. Test Management Phase Planning Guide, Section 3

PURPOSE:

1. Demonstrate engine-out (failure state) concepts previously studied and apply engine-out flight test techniques and related MIL STD paragraphs.

2. Practice conducting flight testing with real-time data monitoring and on-board test directing.

AIRCRAFT:

C-141A, recommend 65K fuel load.

LIMITATIONS:

1. Simulated engine failure (by throttle chop) on takeoff must be accomplished after airborne with a positive climb indication.

2. Minimum altitude for approach to stall, V_{mca}, and engine-out approach and go-around investigation is 5,000 ft AGL. Recovery from approach to stalls must be initiated at shaker onset speed or computed shaker onset speed, whichever occurs first.

3. All engine failures will be simulated by setting idle thrust. EXCEPTION: One engine will be shutdown for V_{mca} determination using the varying airspeed method. Two engine go-arounds will not be performed; if a go-around becomes necessary, use all four engines. In flight, the maximum thrust setting is maximum rated thrust (MRT, 30 minute time limit). EXCEPTION: Go-Around EPR (in-flight Takeoff Rated Thrust, 5 minute time limit) will be used for V_{mca} determination using the constant airspeed method and for the engine-out go-around.

4. Pilot reaction time will be simulated by no more than a three-second delay, or two seconds in the pattern. Use extreme caution in recovering the aircraft.

5. Angle of sideslip will be limited to approximately 15° during engine out operations. (This is not a flight manual limitation but is designed to minimize sideloads, especially with the rudder in the high pressure mode above 160 KCAS).

GENERAL:

1. The purpose of this mission to familiarize the pilots and FTE/Ns with engine-out (failure state) flight test techniques and to gather data for a report. Only selected build-up steps normally performed during this type of testing are included on this sortie. During each pilot event, data will be recorded by the FTE/N. The C-141 flight engineer will determine takeoff and landing data as well as all required in-flight parameters (e.g., MRT, V_{stall}, etc).

2. One mission will be flown in the C-141 with two pilots and one (or two) FTE/N(s).

3. The student FTE/N will keep an event log during the flight. Hand-held data will be collected if the instrumentation system is inoperative. Data will be recorded to meet requirements of the Engine-out Report (see Section 3 of the Test Management Phase Planning Guide).

MISSION EVENTS:

1. <u>Mission Preparation</u>.

The students should plan this mission as a team to gather all required data. Data cards should be prepared which will facilitate data recording in flight. A great deal of data must be recorded in a short period of time so an orderly plan should be devised. The pilots will share in the accomplishment of the test points. The team should come prepared to discuss engine-out theory learned during the engine-out academics phase as well as the interval planned to simulate pilot reaction times during the mission. The team should also be prepared to discuss the C-141 flight manual procedures for 1) Engine failure/fire during takeoff, 2) One engine inoperative landing, and 3) 3 engine go around.

2. <u>Briefing.</u>

IP: conduct general briefing

FTE/N: brief test maneuvers and data requirements

3. <u>Engine Start.</u>

4. <u>Performance and EAR Ground Block.</u>

Particularly note the maximum flight control surface deflection in relation to the cockpit control position.

5. <u>Normal Takeoff.</u>

Note takeoff trim settings for use during subsequent testing.

6. <u>Climb to 11,000 ft at 250 KCAS.</u>

7. Trim Shot at 11,000 ft, 155 KCAS, TO (Gear Down, Flaps Approach, Yaw Damper -On, Rudder-High Pressure).

The pilot will establish a trim shot at the conditions specified. Note that 4.6.5.1 does allow the gear to be retracted for V_{mca} investigations (TO configuration). The gear may be left up at the IP's discretion for fuel considerations. Record β. This reference will be used to identify $\beta = 0$ during the remainder of the flight. If a β gauge is not available, as an approximation use a windshield-mounted yaw string and successive releases from steady-heading sideslips to calibrate it.

CAUTION

DUE TO SIGNIFICANT INCREASE IN RUDDER AUTHORITY, EXERCISE CAUTION WITH RATE OF RUDDER PEDAL APPLICATION WHEN OPERATING IN THE HIGH PRESSURE MODE (ESPECIALLY ABOVE 160 KCAS).

8. Effect of Bank Angle (11,000 ft ±1,000 ft).

The effect of bank angle on control forces and sideslip with the #3 and 4 engines at idle and #1 and 2 engines at military rated thrust (MRT) will be demonstrated. The student will practice the following stable points (i.e. steady heading) and note ϕ, β, F_r, F_a and position of ball and turn needle. Also, compare performance (i.e., drag) by recording VVI at each point.

a. $\phi = 0°$ (use rudder alone to center ball and turn needle).

b. ϕ for $\beta = 0°$. Bank away from the "failed" engines & reduce rudder force until $\beta = 0°$.

c. Increase ϕ away from the "failed" engines until reaching $F_r = 0$.

d. Increase ϕ (2 to 3°) from that required for $F_r = 0$ so that top rudder is required.

e. Reestablish $\phi = 0°$. Then use a small bank angle (restrict to less than 5°) into the "failed" engines.

9. Handling Qualities with Simulated Engine Out (11,000 ft ±1,000 ft).

At 155 KCAS, investigate low bandwidth handling qualities (Phase 1) with heading and/or bank angle captures (use 30 degrees maximum bank).

10. 1G Approach to Stall (TO, 11,000 ft).

Qualitatively evaluate 4 and 3-engine approach to stalls as a build-up to V_{mca} testing. Trim at 1.4 V_{stall} and note computed shaker onset speed.

a. Perform an approach-to-stall investigation using TLF on all four engines.

b. With TLF set on 4 engines, simulate a failure of an outboard engine and perform a

3-engine approach-to-stall investigation. Note any differences from a., especially any yaw or roll-off tendencies or excessive control forces.

NOTE

It is important to use a low to moderate thrust setting to avoid doing V_{mca} testing at this point. If control deflection or force limits are approached, the maneuver should be terminated.

11. Static Air Minimum Control Speed (V_{mca}) Determination - Constant Airspeed Method (11,000 ±1,000 ft).

The test team will collect data to determine static air minimum control speed using the constant airspeed method.

a. At 11,000 feet, TO configuration, establish a stable point 15 knots above stall warning using TLF on all 4 engines. Note EPR.

b. The pilot will simultaneously apply full right rudder and bank the aircraft to maintain a constant heading. Record EPR, ϕ, OAT, H_c, V_c, Mach and gross weight. Perform three more constant airspeed points for data using incremental asymmetric thrust settings. The IP will reduce EPR a small amount on the #1 and 2 engines while increasing EPR an equal amount on the #3 and 4 engines. Initially, bank may be into the lower thrust engines, opposite the rudder. The last of the three points should be with the maximum asymmetry achievable (idle on #1 and 2 engines, Go-Around EPR on #3 and 4).

12. Static V_{mca} Determination - Varying Airspeed Method (7,500 ft ±500 ft, TO).

The effect of the loss of one engine on control will be determined by the test team using the varying airspeed method.

a. At 7,500 feet, 155 KCAS, TO configuration, the #4 engine will be shutdown and the #1 engine set to MRT. The inboard engines may be set symmetrically to an intermediate setting to help in staying within the altitude band. Maintain 155 KCAS with pitch and establish wings-level, straight flight (ball and turn needle centered). Record data (F_r, δ_r, F_a, δ_a, β, ϕ, V_c).

b. Maintaining ϕ=0° and straight flight, the pilot will continue to reduce speed at 0.5 kts/sec using longitudinal control, stabilizing at every 10 knot reduction to record data. Continue until V_{mca} for ϕ=0° is reached. It may be necessary to go to F_{rmax}, F_{amax}, δ_{rmax}, δ_{amax}, or to stall warning (stick shaker). Record data at this point.

Note: Since this point can be plotted on a C_{n_T} vs CLsin ϕ plot, record data as in the constant airspeed method also.

c. Switch Pilots. If F_r or δ_r was the limiting factor, determine V_{mca} for $\phi=5°$. Starting at 7,500 feet, 155 KCAS, establish straight flight using $\phi=5°$ away from the failed engine. Record data as in the wings-level case during the slowdown. Continue to decelerate until reaching V_{mca} for $\phi=5°$, but not below stall warning.

NOTE

Stall may be reached before attaining the minimum control speed. If stall is reached before one of the force or deflection maximums are attained, then the aircraft is controllable down to stall.

CAUTION

DO NOT RELEASE THE RUDDER IF STALL WARNING IS ENCOUNTERED. THIS WILL CAUSE THE SIDESLIP TO INCREASE RAPIDLY WITH A RESULTANT ROLL INTO THE FAILED ENGINES. A COMBINATION OF HIGH AOA AND β COULD PRODUCE A DEPARTURE. IF LATERAL OR DIRECTIONAL CONTROL IS LOST, IT CAN BE REGAINED BY LOWERING THE NOSE TO INCREASE AIRSPEED, OR REDUCING POWER ON THE OPERATING ENGINES.

Restart the inoperative engine at the completion of this event.

13. Dynamic Effects on Engine-Out V_{mca} (7,500 ft, TO).

The effect of a sudden engine failure on engine-out static V_{mca} will be evaluated by the test team at the engine-out static V_{mca} ($\phi=5°$) just determined. If the test team finds the C-141 controllable down to stall warning, the dynamic test point will be flown 5 KCAS above stall warning (approximately 1.1 V_{stall}).

a. The pilot will begin a climb at 6,000 feet in the TO configuration using MRT on all 4 engines and establish the proper airspeed. Ensure takeoff trim is set and maintained.

b. At 7,500 feet the IP will retard the #4 engine to idle.

CAUTION

THE AIRSPEED DECREASE AFTER A DYNAMIC ENGINE FAILURE MAY BE QUITE RAPID SINCE THE AIRPLANE IS IN A HIGH NOSE-UP ATTITUDE.

c. After delaying recovery to simulate a realistic reaction time, the pilot will attempt to recover to straight flight using up to 5° bank away from the "failed" engine at the original

stabilized airspeed. Record the maximum ϕ, Ψ, V_c and β excursions as well as pilot control forces and deflections used for recovery. Add pilot comments, including failure cues, recovery technique and any limiting factor.

14. Static V_{mca} Determination - Constant Airspeed Method (8,000 ft, +1,000 ft, -500 ft). Collect data as before at a different altitude.

15. Engine-out Approach and Go-Around (8,500 ft, $V_{approach}$, Gear Down, Flaps Landing). The effect of the loss of an engine on final approach will be evaluated. In addition to the performance data collected, qualitative comments on handling qualities should also be recorded.

a. At 8,500 feet set up a normal 4 engine final approach simulating a 3° glide slope (VVI approx 600-700 fpm). Note the power setting (EPR or fuel flow). Some low gain tracking tasks (heading or bank angle capture) may be performed into and away from the failed engine (MIL STD specifies up to 20° bank).

b. Simulate failure of the #1 engine and delay an appropriate time to simulate reaction time before recovering to steady straight flight and reestablishing a 3° glide slope. Qualitatively evaluate the transient effects and ability to recover and note the new power setting.

c. Then execute a three-engine go-around using MRT and flight manual procedures. Qualitatively evaluate the maneuver.

16. (Optional) Engine-out Climb Performance (9,000 ± 500 ft). A series of sawtooth climbs will be flown from 8,500 ft to 9,500 ft using MRT on #2, 3 and 4 engines to evaluate engine-out climb performance. The FTE/N should record the following parameters at the bottom and top of the altitude band: V_c, TAS, β and time. The three different climb out/go-around configurations to be tested are:

(1) Gear-up, Flaps-approach, V_{mco}, $\phi=0°$.
(2) Gear-up, Flaps-approach, V_{mco}, $\phi=5°$.
(3) Gear-up, Flaps-approach, V_{mco}, $\beta=0°$.

Again switch pilots after this event.

17. Engine-Out Patterns (Palmdale/Edwards). Note: for fuel considerations the IP may elect to complete engine out patterns first prior to up and away points. A buildup approach will be used in all cases to collect data (for example, ensure pilot proficiency with 4-engine approach prior to performing 3-engine). Qualitatively evaluate the aircraft during engine-out patterns. The pilots will each accomplish the following

(time permitting):

a. Fly a normal touch and go. After takeoff with a positive rate of climb, the IP will retard an outboard throttle (should be varied between pilots) to idle. Allow a maximum of 2 seconds for pilot reaction time and then proceed with Flight Manual Procedures. Evaluate the handling qualities through the turn to downwind.

b. Fly an engine-out pattern to an engine-out go-around IAW the Flight Manual.

c. Fly an engine-out landing. At the discretion of the IP, one pilot may fly a two engine-out landing instead.

CAUTION

(1) USE EXTREME CARE WITH POWER APPLICATIONS IN ALL ASYMMETRIC THRUST OPERATION, ESPECIALLY AT LOWER ALTITUDES.

(2) THE FIRST AND MOST PROBABLE INDICATION OF ENGINE FAILURE ON THE GROUND OR JUST AFTER LIFT-OFF WILL BE THE ASSOCIATED AIRPLANE YAW. COORDINATED RUDDER AND AILERON MUST BE APPLIED TO CONTROL THIS YAW. OVER-CONTROLLING WITH THE CORRECT RUDDER AND/OR AILERON IS AS DANGEROUS AS APPLYING THE WRONG RUDDER.

(3) IT IS CRITICAL THAT THE PILOT NOT MECHANICALLY APPLY THE RUDDER ASSUMED TO BE CORRECT. THE INCORRECT APPLICATION OF RUDDER CAN PLACE THE AIRCRAFT IN A CONDITION WHERE SAFE RECOVERY MAY NOT BE POSSIBLE.

18. Debrief.

The test team should discuss with the IP the following as determined from the flight: (1) bank angle effects on control forces and sideslip, and (2) bank angle effects on V_{mca}. Use graphical results from the flight to reinforce the conclusions.

INSTRUMENTATION:

The DAS and strip-chart should be the primary data collection devices. Cockpit gauges can be used as a back-up. Other hand-held data collection devices may be brought on the mission at the discretion of the IP.

DATA REDUCTION/REQUIRED PLOTS/PRESENTATION/REPORT:

Use DAS - or strip-chart recorded data (hand-held back-up). Complete an Engine-out Report as directed in the Test Management Phase Planning Guide, Section 3.

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FLYING QUALITIES FTT

REFERENCES:

Flying Qualities Textbook

PURPOSE:

1. To maintain basic aircraft proficiency.

2. To practice flight test techniques learned in the Flying Qualities Phase.

GENERAL:

Student FTT missions will be scheduled as necessary throughout the phase to ensure student proficiency. The order of events may be varied.

AIRCRAFT:

T-38, F-16, F-15, C-23 or C-141

LIMITATIONS:

1. Aircraft flight manual and test plan limits. For the T-38, a maximum of 6 gs or moderate buffet, whichever occurs first.

2. Those listed in Appendix B, Safety Review Board, of this guide.

3. Students may only practice FTTs that they have been demonstrated on the appropriate demonstration sortie.

MISSION EVENTS:

1. Mission preparation/briefing.

2. Preflight/Ground block (Mark aileron deflection).

3. Mil or Max Power Takeoff.

4. Mil or Max Power Climb.

5. Trim Shot (CR or PA).

6. N/α sweep.

7. Dynamics (Dampers/CAS ON and OFF).
   a. Short Period - Singlet/Doublet
   b. Dutch Roll - Singlet/Doublet/Sideslip Release
   c. Spiral Stability
   d. Phugoid

8. Aileron Rolls.

9. Steady Heading Sideslip. (NOTE: For T-38 in PA configuration, use 20° bank maximum)
   a. Stabilized
   b. Slowly varying

10. Model Validation. (Doublets/sweeps)

11. Long Stat.
    a. Accel/Decel
    b. Stabilized

12. Maneuvering Flight.
    a. Stabilized Method
    b. Slowly Varying

13. Trim Effects

14. Flight Path Stability.

15. Touch and Go Landings.

16. Debriefing.

INSTRUMENTATION/DATA REDUCTION/REQUIRED PLOTS:

None.

C-23 FLYING QUALITIES DEMO (PILOT/FTE/N)

REFERENCES:

1. C-130 Flight Characteristics, ACQ-432-10
2. Airplane Aerodynamics and Performance, Lan & Roskam

PURPOSE:

This demonstration flight will introduce the Test Pilot student to several propeller effects that will effect the handling qualities of a multi-engine aircraft. Additionally, this flight will introduce the student to a variety of low altitude techniques that have been successfully employed by low and medium performance aircraft in the low-level environment.

AIRCRAFT:

C-23A

LIMITATIONS:

Aircraft flight manual limitations and AFFTC Form 5028 limitation will apply.

GENERAL:

1. Two pilots will fly on a single 2.0 hour sortie. Each pilot will get an opportunity to fly each event done in the area. For the pattern work, both pilots will fly a normal and offset landing. However, only one pilot will fly the simulated single engine go-around. The other pilot student will fly a simulated single engine landing.

2. Each student should become familiar with the following low altitude techniques employed in low and medium performance aircraft.

a. Verbalizing hazards: Cargo/bomber type aircraft generally do not have as much visibility as a fighter might have. Plus cross cockpit visibility is also only fair. Thus, using the entire crew to identify hazards to navigation is worthwhile. To ensure the entire crew is aware of an upcoming hazard, each hazard should be verbalize by the crewmember that spots it. Once the hazard is announced, the pilot flying the airplane should respond positively to the announcement if he was not the one who made it.

b. Calibrating your eyes: The ground can be deceiving. There is a great tendency

for a pilot to gradually fly lower and lower over time. This is especially true over the desert where there is relatively little vertical vegetation to provide depth perception. Thus, the radar altimeter becomes an important part of your cross-check by allowing you to recalibrate your eyeballs every few minutes.

c. Being aware of wing tip location: The C-141, the B-52, and other similarly sized aircraft have relatively large wing spans. If you do not remain cognizant of them, you could easily drag them into trees along a ridge line, through the rocks on a passing butte, or through the dirt while making a steep turn. Bring your wing tip area into your scan when you are getting close laterally to terrain.

d. Preplanning climbs: Long climbs need to be preplanned on the ground or prior to the start of the climb. This preplanning will help prevent you from flying into excessively steep terrain. However, misjudgments can be easily made even with preplanning. Thus, don't try to hug the terrain during a steep climb. Always have a way out if you do misjudge the climb or if you lose an engine. The 'way out' is usually a 90 or 180 degree turn.

e. Predicting turbulence: For a low G aircraft, severe low level turbulence can rip the wings off or drive an airplane into the ground. Of course, severe turbulence is often preceded with moderate turbulence. Thus, consider terminating a low level when moderate turbulence is encountered. Usually, it is not very comfortable and you are probably not getting good data or training. Severe turbulence, however, is not always preceded by any warning. Learn where to look for turbulence. Look at your INS for the winds; then look at the terrain. If you are going into an area downwind of some significant terrain in moderate winds, approach with caution. Do not fly directly into suspicious areas. Enter them obliquely so that you can have a quick exit if trouble ensues.

3. Propellers can have unique effects on an aircraft's flying qualities. There are five effects that are commonly seen in propeller aircraft. This demonstration flight will look at four of them. The five effects are as follows.

a. Sidewash: Friction between the propellers and the air will start the slipstream behind the propellers to rotate. This rotation is in the direction of rotation of the propellers. For US engines, this is clockwise when viewing the propeller from the tail to the nose. The horizontal component of this rotation will induce an AOA on the vertical tail. This AOA results in a horizontal force on the tail pushing the tail to the left, in other words, causing a right sideslip. The magnitude of the sidewash is affected by two

major factors. One is the true airspeed, the other is power setting. The slower the airspeed or the greater the power setting the greater effect sidewash has on an aircraft. In fact, sidewash is generally the most predominate propeller effect of an aircraft.

b. 'P' Factor: An unbalanced force occurs when the propeller plane is not perpendicular to the relative wind. For example, if the axis of rotation is offset above the aircraft's relative wind by several degrees, the downward moving blade will be at a higher AOA than the upward moving blade. This difference will create a de-centered thrust on the propeller disk. For an US engine (clockwise rotation), the thrust will be de-centered to the right when the AOA is increased beyond the point where the axis of rotation is aligned with the aircraft's relative wind. This will cause the nose of the aircraft to be pulled left causing a right sideslip.

c. Torque Effects: Newton stated in *Principia* that "to every action there is always opposed an equal reaction." Thus, when the propellers are propelled clockwise by the engines there is a reaction force trying to roll the airplane the opposite direction. If you recall from your physics or engineer statics course, the torque does not have to be along the centerline to produce a rolling moment. Thus, from a trimmed condition, for a multi-engine aircraft with US engines, increasing torque will create a left rolling moment and decreasing torque will roll the airplane right.

d. Gyroscopic Effect: Remember your gyroscopic theory. The right-hand rule applies. Point your right-hand fingers in the axis of rotation. Next, curl your fingers in the direction of the applied force. You thumb now points in the direction of the resultant force. For example, during aircraft rotation or flare, the resultant force is pulling the nose right. This is completely opposite of the sidewash and "P" factor effects during this phase of flight. However, in a tail dragger, like a Stearman, the nose is rotated down causing a left gyroscopic force. This force is additive with sidewash and 'P' factor.

e. Power-on versus Power-off Stalls: Wing mounted propellers provide energized air to a significant portion of the wing. Thus, in the power-on configuration, the wings sees air with a higher Reynolds number, and the air is able to stay attached to the wing at a higher AOA. This is equivalent to the lift curve being moved left and up for a typical airframe. You can observe this effect by doing power-on and power-off stalls and noting the stall speed differences. The 'blown wing' effects can also be seen in the flare if rapid changes in power are made. For example, a rapid power reduction quickly shrinks the shape of the lift curve and can lead to a hard landing.

MISSION EVENTS:

1. Mission Preparation

The student team will prepare data cards from the events listed on the grade sheet in appendix A. Appropriate data should be collected to enable the students to compare their results with that of theory.

2. Briefing

The instructor pilot will brief the general mission. The students will be prepared to discuss the different events to be flown.

3. Takeoff

Normal 4^0 Flap Takeoff

4. 500' AGL Low Level

The low level flight will last for approximately 15 minutes. The route will go from Hwy 58 to Black Mountain and then continue east on the Black Mountain TFR

Black Mountain: N 35 11.5 W 117 27.5 4584'
Black Mountain TFR: N 35 11.0 W 117 25.0 to
N 35 11.0 W 117 02.0

5. Sidewash Demo

Trim shot at 160 KIAS or 740 ITT whichever is lower and 8000' PA. Increase power to 800^0 ITT or 3500 ft-lb whichever is lower (rudder free) and note ball deflection. Decrease power to flight idle from trimmed conditions (rudder free) and note ball deflection.

6. 'P' Factor Demo

Trim shot at 160 KIAS or 740 ITT whichever is lower and 8000' PA. Perform a stabilized G wind up turn to the left and the right. Stabilize at 30^0, 45^0, and 60^0 of bank. Note ball deflection at each point. Compare the ball deflections between your left and right wind up turns. A ball deflection bias should indicate the effect of 'P' factor.

7. Torque Effect Demo

Trim shot at 140 KIAS and 8000' PA with propellers at 1675 PRPM. Note torque values. Slowly retard propellers to 1200 PRPM. Note rolling tendencies.
Retrim the aircraft at 140 KIAS and 1200 PRPM. Note torque values. Slowly increase

propellers to 1675 PRPM. Note rolling tendencies.

8. 1 G Approach to Stall, 8000' PA

Slow the aircraft to stick shaker speed with the power in flight idle. Note stick shaker speed. Next slow the aircraft to stick shaker speed with the power set to 1700 ft-lb. Note stick shaker speed.

9. Simulated Single Engine Slow Flight, 8000' PA

Configure the aircraft with 15^0 flaps, gear down, and propellers at 1675 PRPM. Fly turns into and away from the simulated bad engine at minimum approach speed.

10. Switch Pilot Students and Repeat Steps 5-9

11. 500' AGL Low Level

Fly course flown by other student except in the reverse direction.

12. Pattern Work

The following patterns will be flown:

Both students will fly a normal landing

Both students will fly an offset landing task. Initiate task at 250' AGL offset by 300'.

One student will fly a simulated single engine landing

One student will fly a simulated single engine go around

13. Debrief

The students will debrief flight results and compare them with theory.

INSTRUMENTATION:

None

DATA REDUCTION/REQUIRED PLOTS:

None

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SECTION IV
HIGH ANGLE-OF-ATTACK TRAINING

The High Angle of Attack syllabus starts with the T-39 Near Stall/Stall Demonstration. The remainder of the mini-syllabus consists of the Glider Spin Demonstration, T-2 Spin Demonstration/Data and F-16 Departure Demonstration.

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NEAR STALL/STALL DEMONSTRATION (PILOT/FTE/N)

REFERENCES:

1. Flying Qualities Textbook, Supplementary Material
2. MIL-STD-1797A
3. MIL-F-83691B (USAF)
4. T.O. 1T-38A-1

PURPOSE:

1. To demonstrate and practice flight test techniques associated with approach to stall, stall and lift boundary determination.

2. To evaluate the stall characteristics of the T-38 for the advanced trainer mission and compliance with MIL-STD-1797A.

3. To increase one's ability to observe and record stall flight test data.

4. To demonstrate and practice flight test techniques for Phase A departure/spin susceptibility investigations (Phase B, C and D stalls are flown on spin missions only).

AIRCRAFT:

A/T-38A/B

LIMITATIONS:

Flight Manual restrictions will apply to all approaches to stall and stalls. The following guidelines are provided for each maneuver:

a. Flight Manual Limitations (refer to T-38 flight manual).
   (1) Minimum power setting of 80% below 200 KIAS and above 20,000 ft MSL.
   (2) Intentional spins are prohibited.

b. Approach to Stall.
   (1) Recovery will be initiated at the first indication of moderate buffet.
   (2) Recovery will be completed by 10,000 ft AGL.

c. Stalls.

(1) Recovery from stalls will be initiated when the pilot has a clear indication of any of the following:

(a) Definite G break.

(b) Rapid, uncommanded angular motion.

(c) The aft stick stop has been reached and AOA is not (or pitch angle if AOA not available) increasing.

(d) Sustained intolerable buffet.

(2) Recovery will be completed by 10,000 ft AGL.

MISSION EVENTS:

1. Mission Preparation.

Normal crew complement will include a pilot/FTE/N with IP. Students will prepare data cards for the entire flight profile and provide a copy for the IP. They should research the T-38 Dash-1 (Fig 6-2) to determine the 1.0 and 2.0 G stall speeds anticipated for the aircraft in the cruise configuration for the gross weight anticipated 10 minutes after takeoff (approximately 10,000-11,000 lbs).

2. Briefing.

The IP will brief the flight profile and include test techniques and data taking techniques. Pre-stall trim check and spin recovery procedures will also be briefed.

3. Ground Block.

Pilot will perform a flying qualities ground block.

4. Takeoff/Climb.

The pilot will perform the takeoff and will climb in the most efficient manner to arrive in a suitable area at 20,000 ft MSL and 230 KIAS.

5. Trim Shot.

The pilot will perform a trim shot at 20,000 ft MSL and 230 KIAS (approximately 1.4 V_{STALL} in the cruise configuration (CR)). This will be used as a baseline for the next maneuver.

6. Flying Qualities, Near Stall, 1G (CR).

The instructor will demonstrate, and the pilot will practice an investigation of near stall flying qualities. At trim speed and power, and investigating one aircraft axis at a time, the instructor will make a small step input with the control and note primary and secondary aircraft responses, control forces, and relative control effectiveness. The pilot will then stabilize at a slower airspeed without retrimming. For actual stall investigations, the airspeed should be reduced in increments of two to three knots or less; however, a larger increment (5-10 knots)

may be used for this demonstration. The pilot will note any change in stick force required to hold the new airspeed and repeat the control effectiveness/aircraft response investigation. The pilot will pay particular attention to the relative ease with which the angle-of-attack can be controlled. If the flying qualities are acceptable, the pilot will continue this process down to stall warning. The pilot will then decide on the proper stall recovery technique based on the results of the investigation. Data band 20,000 ± 2000 ft.

7. Trim Shot.
Perform a trim shot at 20,000 ft MSL and 200 KIAS (approximately 1.2 V_{STALL}) in the cruise configuration.

8. Stall, 1G (CR).

a. The IP will demonstrate and the pilot will practice a 1G stall in the cruise configuration at trim power setting. The stall will be performed in straight flight starting at 200 KIAS. The airspeed will be reduced at a rate of approximately one knot per second to minimize dynamic effects. If a slight climb is used during the airspeed bleed off, the entry altitude should be adjusted so that the stall occurs within a data band of ±1000 ft. Start data recording prior to beginning the stall "run in". Use aileron/rudder to counter the rolling tendencies. Recovery should be initiated at the first positive indication of the stall. Immediately neutralize all controls, evaluate any post stall gyration tendencies and attempt to return to level flight adding power only after the stall AOA is broken. Record the nature of the warning of the stall, stall speed, stall AOA (if available), stall altitude, recovery characteristics, and total fuel remaining.

b. Repeat the 1G stall with an emphasis on minimizing altitude loss during recovery. Use caution on rate of power application during recovery to avoid engine stalls.

9. High Bleed Rate Stall, 1G (CR).
The student will practice a high bleed rate stall (approximately 5 knots per second) and note the difference in stall speed due to dynamic effects. Use the same trim power setting as 7. above.

10. Lift Boundary Determination (CR).
At 20,000 ft MSL and 250 KIAS, the IP will demonstrate the "instantaneous" G available with a slowly varying wind up turn. The pilot will repeat the maneuver. This technique determines the lift boundary by maintaining a constant airspeed and increasing G.

11. Full Aft Stick Stall Demo (CR) (Optional).
The IP will demonstrate a full aft stick stall to show the point where AOA is limited by elevator authority.

12. Trim Shot.
The pilot will perform a trim shot at 20,000 ft MSL and 280 KIAS (1.4 V_{STALL} for 2Gs) to be used as a baseline for the next maneuver.

13. Flying Qualities, Near Stall, 2Gs (CR).
The IP will demonstrate and the pilot will practice a method of investigating flying qualities at high angle-of-attack and a load factor greater than one. The actual method used to determine flying qualities during approaches to accelerated stalls will be determined largely by the type of aircraft, the instrumentation available and the results of the 1G stall evaluation. For demonstration purposes in the T-38, the following technique will be used. The pilot will enter a turn at 20,000 ft MSL, 2Gs. The pilot will observe and remark on flying qualities in the same manner as at 1G.

NOTE

The important part of this maneuver is noting how the aircraft "feels" (control forces required, aircraft responsiveness, etc.), rather than extremely precise "G" control.

The airspeed will be reduced in 5 or 10 knot increments depending upon IP direction. This investigation will terminate at stall warning. The 2G stall speed can be estimated as 1.4 times the previously determined 1G stall speed. Data band 20,000 +/- 2000 ft.

14. Trim Shot.
The pilot will perform a trim shot at 20,000 ft MSL and 240 KIAS (approximately 1.2 V_{STALL} for 2G's).

15. Stall, 2G (CR).
The instructor will demonstrate a method of determining accelerated stall characteristics by performing a 2G stall. The pilot will repeat the maneuver. Starting from the trim condition at 20,000 ft MSL, the pilot will roll into a turn and establish 2Gs. He will maintain a steady 2Gs with elevator, using outside references, and he will adjust his pitch with respect to the horizon by varying bank, in order to attain the desired airspeed bleed rate. For this demonstration, the aim bleed rate will be two knots per second. Entry conditions should be adjusted to stall within a data band of ±1000 ft. Record the same data as the 1G stall; pay particular attention to differences. The objective of recovery for this accelerated stall entry is to return to a maneuverable condition, as might be encountered in the traffic pattern. Use recovery control inputs as required (and determined by the 2G near stall investigation) to achieve this objective.

16. Phase A Stall.

Establish a trim shot at 20,000 ft MSL and 200 KIAS in the clean configuration. Using previously practiced techniques, establish a 1 kt/sec bleed rate to a complete stall. The objective of this stall and recovery is to determine stall/spin susceptibility, so at the first indication of stall, briskly neutralize all controls and evaluate any post stall gyration (PSG) for departure tendency. When any PSG ceases perform a normal stall recovery and measure altitude loss during recovery. MIL-F-83691B permits "small control deflections as necessary for the task" during the approach to stall. For our purposes, we will define the task as maintaining wings level, coordinated flight. If fuel and time permit, repeat the stall using neutral aileron and rudder during the approach to stall/stall. Note any tendencies for uncommanded roll and yaw.

17. Trim Shot.

The pilot will trim the aircraft at 18,000 ft PA and 180 KIAS in the power approach (PA) configuration (gear down, flaps 60%, speed brake in).

18. Stall Warning and Stall Investigation 1G/1.4G (PA).

Determine stall characteristics and the airspeed for stall warning/stall. With trim set, repeat the stall investigation at approximately 1.4 g (45 degrees bank). Data band 18,000 ± 1000 ft.

19. FTE/N Practice.

Time permitting, the student FTE/N may practice any of the approach to stall/stall techniques.

20. Ground Block.

The pilot will accomplish a post flight ground block.

21. Debriefing.

INSTRUMENTATION/DATA REDUCTION/REQUIRED PLOTS:

Hand record data and use a voice tape recorder if desired. No data reduction is required.

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GLIDER SPIN DEMO (P/FTE/N)

REFERENCES:
1. USAFTPS Sailplane Aircrew Aid
2. USAFTPS Flying Qualities Textbook, Chapter 10
3. USAFTPS OI 60-2, "Soaring"
4. AFFTC-TR-89-27, "Schleicher ASK-21 Glider (TG-9) Stall and Spin Evaluation"
5. T.O. 1G-9(T)A-1, TG-9A (ASK-21) Flight Manual (USAFA)

PURPOSE:

To provide spin indoctrination training.

AIRCRAFT:

ASK-21

LIMITATIONS:
1. FAR, Parts 61 and 91.
2. Contractor local operating procedures.
3. Parachutes will be worn on all sorties.
4. No cassette recorders will be carried in the aircraft.
5. Minimum altitude are:
    a. Spin entry 2,500' AGL
    b. Initiate flight manual recovery 2,000' AGL
    c. Wings level recovered (spin and loop) 1,500' AGL
6. Recoveries other than the flight manual recovery will not be held for more than two (2) turns. If not recovered, immediately apply the flight manual recovery procedure.
7. Maximum speed with tail weights installed is 108 KIAS.
8. No aerobatics or inverted entries to spins are allowed with tail weights installed.
9. The acceleration limits of +5.3 to -3.0 will be used for all airspeeds.

GENERAL:
1. FTE/Ns may ride in the front seat.

2. While there is no requirement for flying proficiency in any maneuver, FTE/Ns are encouraged to attempt maneuvers when no conflict with the lesson's desired learning objective is encountered (CFI-G on board required!)

3. For the glider spin demo, pro-spin controls are defined as full rudder and full aft stick with ailerons neutral.

4. Normal recovery procedure is to move from pro-spin to neutral and then initiate the recovery procedure. In the glider spin demo, the controls will be moved directly from the pro-spin to the desired recovery (and if required to the flight manual recovery) position. This precludes a neutral recovery prior to initiating the desired recovery and it reduces the altitude lost during each spin and recovery.

5. Normal control inputs for spin entries and recoveries are brisk, step inputs. During all recoveries, care must be taken to avoid brisk full forward stick. This will result in high negative Gs and it could result in an inverted stall. Any forward stick movement will be smooth and steady and it WILL be stopped as soon as the aircraft unloads.

6. Normally T-2 spin turns are counted after the incipient phase ends and once the spin is developed. During the glider spin demo, spin turns will be counted from the initiation of pro-spin control input. This will reduce the altitude lost during each spin.

RECOVERIES:

1. <u>NASA - Standard.</u>
   a. Ailerons neutral.
   b. Full opposite rudder.
   c. Full back stick.
   d. When rotation stops; neutralize rudder.
   e. Ease stick forward to neutral.

2. <u>NASA - Modified.</u>
   a. Ailerons neutral.
   b. Full opposite rudder and stick forward to neutral.
   c. Neutralize rudder when spinning stops.

3. <u>NASA - Neutral.</u>
   Neutralize all controls.

4. Flight Manual.
   a. Rudder - full opposite direction of spin.
   b. Stick - forward.
   c. Controls - neutral after spinning stops and recover from dive.

NOTE

The Flight Manual recovery for the aircraft is the only approved recovery. These other recoveries may or may not recover the aircraft and should only be used in an approved training situation with an experienced spin pilot at the controls.

PROCEDURES:

1. Mission Preparation, Briefing and Preflight.

Students will read Section VI (Flight Characteristics) of the USAFA ASK-21 Flight Manual and review AFFTC-TR-89-27 prior to this mission. Each student will be familiar with the profile and will prepare mission cards showing the profiles. Student pilots will fly all the maneuvers except as noted. Student FTE/Ns will practice observational techniques initially and then fly the maneuvers as desired and coordinated with the instructor. The instructor will brief the flight profile, including flight test techniques and data collection procedures. During preflight, particular emphasis will be placed on inspecting the aircraft for freedom of all flight controls and for ballast location. Verify crew weight, check for cockpit ballast (if required), and insure the correct number of tail weights are installed and secure (last two sorties only). A forward CG within aircraft limits is desired for the first sortie and a CG 16 inches aft of datum is required for the last two sorties. If cockpit ballast will be used on the last two sorties (to increase the number of tail weights), then use the same cockpit ballast without tail weights for the first sortie. The student will assist the instructor and contractor personnel in moving the ASK-21 to the takeoff position.

2. Takeoff and Aerotow (4000' AGL)(IP Demo Optional).

The student will demonstrate proper high tow position, how to maintain position, and how to correct position errors. The IP will demo boxing the wash (optional). The student will perform the pre-spin checklist. All except the last step should be completed prior to release.

Prespin checklist.

a. Trim-neutral (tow airspeed)
b. Divebrakes closed/locked
c. Harness - secure
d. Loose items - **stowed**

e. Windows/vents - closed

f. Clear below (after release)

3. Specific Mission Profile.

a. Flight 1 (No Tail Weights).

(1) Phase A Stall. After completing the pre-spin checklist and clearing the area for other traffic, the student will perform a nose high (5°) 1G stall. Notice adverse yaw induced by the ailerons as airspeed decreases. With the ailerons deflected at stall there is sufficient adverse yaw to cause a spin. The ASK-21, like most sailplanes, exhibits large adverse yaw moments due to ailerons, so particular attention is required to have ailerons absolutely neutral for stall/spin entries. (It is possible to enter a *left* spin with full *right* rudder and full right aileron. Therefore, in the ASK-21, pro-spin controls are defined as full rudder and full aft stick with the ailerons neutral.) Recovery should be initiated at the first indication of the stall. For the recovery, apply sufficient forward stick to lower the nose below the horizon and accelerate to 55 KIAS.

(2) Phase B Stall (RH). After clearing the area for other traffic, the student will perform a nose high (5°) 1G stall. At stall entry, input full pro-spin controls, using right rudder, for one second. A NASA neutral recovery will be performed (neutralize all controls and apply forward stick necessary to break the stall).

(3) Phase C Stall (RH). After clearing the area for other traffic, the student will perform a nose high (5°) 1G stall. At stall entry, input full pro-spin controls, using right rudder, for three seconds. Perform a NASA neutral recovery as with the Phase B Stall.

(4) Spins.

(a) 1G Entry, 2 Turns (RH) (IP DEMO). After clearing the area for other traffic, the IP will demonstrate the first spin attempt of this flight. Note the spin entry technique, departure, resulting spin or spiral turn and recovery technique.

(b) 1G Entry, 2 Turns (RH), Flight Manual Recovery. After clearing the area for other traffic, the student will perform a nose high (5°) 1G stall. At stall entry, apply full pro-spin controls with right rudder. Hold the controls firmly to avoid control surface buffeting. After a spiral turn is recognized, or after the second turn of a spin, apply the appropriate spiral or flight manual recovery controls.

(c) Spin Recovery. After the last desired turn of the spin, briskly apply the proper spin recovery controls. Be prepared to immediately release anti-spin controls as the rotation stops and the stall breaks to avoid negative G, secondary spin, or large sideslip angles. If a non-flight manual recovery is not effective within two additional turns or by 2,000 feet AGL (whichever occurs first) immediately transition to the flight manual recovery.

(d) Spiral Recovery. Due to the forward CG, accelerated entry (higher bleed rate) and the greater g break at stall (nose high stall), the above spin attempts may result in a spiral dive. Watch for the spiral versus spin cues; higher airspeed (which may be masked by high yaw rates), higher g forces, higher noise level (due to higher airspeed), and the lack of spin oscillations. To recover from a spiral dive release aft stick pressure, roll out to less than 45° of bank, then reapply controls to recover from the dive.

(5) Loop. THIS MANEUVER CANNOT BE PERFORMED WITH TAIL WEIGHTS INSTALLED. Roll-in or push over to 45° nose low to attain entry airspeed. At 98 KIAS, pull up at 3.5 to 4.0 Gs maintaining wings level. As the nose rises, airspeed and G will decrease rapidly. However, KEEP THE NOSE TRACKING until it approaches the horizon inverted. DO NOT let the aircraft run out of airspeed with the nose vertical - a tail slide can result in major aircraft damage. Momentarily hold the nose on the horizon inverted and then slowly increase aft stick pressure again. This will make the loop rounded versus "egg" shaped. As the nose drops and airspeed increases, the G will increase to the original 3.5 to 4.0 Gs. DO NOT abruptly increase G - pitch sensitivity could result in overstressing the aircraft. Aiming to finish the loop at entry altitude will result in loosing 10 KIAS and aiming to finish at the entry airspeed will result in a loss of 100 feet from the initial pull-up.

b. Flight 2 (Tail Weights Installed, 16" CG).

(1) Phase A Stall. Same as Flight 1. Note the changes in stall characteristics due to the change in CG.

(2) Phase B Stall (RH). Same as Flight 1. Note the changes in stall characteristics due to the change in CG.

(3) Spins.

(a) 1G Entry, 2 Turns (RH), Flight Manual Recovery (IP Demo). The instructor will demonstrate the first spin of this flight. Note the spin entry technique, departure, incipient and developed spin characteristics, recovery and pilot comments.

(b) 1G Entry, 2 Turns (LH), NASA Standard Recovery. After clearing the area for other traffic, the student will perform a nose high (5°) 1G stall. It is important not to get too nose high. An "accelerated" stall could result in a spiral versus a spin. At stall entry, apply full pro-spin controls with **left** rudder. After the second turn, apply NASA standard recovery controls. Be prepared to immediately release anti-spin controls as the rotation stops and the stall breaks to avoid negative G, secondary spin, or large sideslip angles. DO NOT exceed 108 KIAS with the tail weights installed. If not recovered after two turns with the NASA standard recovery immediately input the flight manual recovery controls. Note changes in spin and recovery characteristics due to the change in CG.

c. Flight 3 (Tail Weights Installed, 16" CG).

(1) Phase C Stall (RH). Same as Flight 1. Note the changes in stall and recovery characteristics due to the change in CG.

(2) Spins.

(a) 1G Entry, 2 Turns (RH), NASA Modified Recovery. The student will repeat the spin entry with right rudder. After two turns execute a NASA modified recovery.

(b) 1G Entry, 3 Turns with Aileron Effects, Flight Manual Recovery. The student will repeat the spin entry with left rudder. After the first turn, keeping full left rudder and full aft stick, abruptly apply full left aileron (direction of spin). Note any changes in the spin characteristics during the next turn. After the second turn, abruptly change from full left to full right aileron (opposite the direction of spin) and again note any changes in the spin characteristics during the last turn. After the third turn, initiate a flight manual recovery (if necessary).

4. Thermalling Practice.
The IP will demo and the student can practice thermalling while the student debriefs the mission.

5. Pattern and Landing.
The student will accomplish (IP demo optional).

6. Debriefing.
The student should be able to qualitatively discuss the spinning characteristics including spin sense, pitch attitude, yaw/roll rates, oscillations (SARO), IAS, time per turn, altitude loss per turn, and physiological sensation. The differences in the recoveries should be observed, particularly in the time (number of turns), altitude lost, and complexity. The effects of aileron inputs during the spin and how the inputs relate to the inertial loading of the ASK-21 will be discussed.

INSTRUMENTATION:
All data are hand held collected data and pilot comments.

DATA REDUCTION:
None.

REQUIRED PLOTS:
None.

ASK-21 GLIDER SPIN MISSION 1 - FWD CG

FCP WEIGHT	RCP WEIGHT	COCKPIT WEIGHTS	TAIL WEIGHTS
			*** NONE ***

ALTITUDES (MTN VALLEY)		AIRSPEEDS	
MIN SPIN ENTRY:	6700' MSL	MIN SINK	45 KIAS
FLT MAN REC:	6200' MSL	L/D MAX	56 KIAS
WINGS LEVEL:	5700' MSL	Vmax	108 KIAS

PRE-SPIN CHECKLIST

1. TRIM - NEUTRAL
2. DIVE BRAKES - CLOSED/LOCKED
3. HARNESSES - SECURE
4. LOOSE ITEMS - SECURE
5. WINDOWS/VENTS - CLOSED
6. CLEAR BELOW

TYPE	ENTRY	RECOVERY
1G PHASE A STALL	5° NOSE HIGH 50 KIAS	NEUTRAL
1G PHASE B STALL RIGHT RUDDER	5° NOSE HIGH 50 KIAS (1 SEC)	NASA NEUTRAL
1G PHASE C STALL RIGHT RUDDER	5° NOSE HIGH 50 KIAS (3 SEC)	NASA NEUTRAL
1G RIGHT RUDDER (IP DEMO)	5° NOSE HIGH 50 KIAS 2 TURNS	FLT MAN
1G RIGHT RUDDER	5° NOSE HIGH 50 KIAS 2 TURNS	FLT MAN
LOOP	45° NOSE LOW 98 KIAS	

CHECKLISTS

BEFORE TAKEOFF		BEFORE LANDING	
1. ALTIMETER	5. CANOPY	1. TRAFFIC	4. GEAR
2. BELTS	6. DIVE BRAKES	2. WINDS	5. SPOILER
3. CONTROLS	7. WIND	3. RUNWAY	6. SPEED
4. CABLE	8. EMERGENCIES		

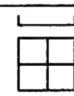
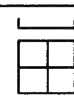
ASK-21 GLIDER SPIN MISSION 2 - 16" CG

FCP WEIGHT	RCP WEIGHT	COCKPIT WEIGHTS	TAIL WEIGHTS

ALTITUDES (MTN VALLEY)		AIRSPEEDS	
MIN SPIN ENTRY:	6700' MSL	MIN SINK	45 KIAS
FLT MAN REC:	6200' MSL	L/D MAX	56 KIAS
WINGS LEVEL:	5700' MSL	Vmax	108 KIAS

PRE-SPIN CHECKLIST

1. TRIM - NEUTRAL
2. DIVE BRAKES - CLOSED/LOCKED
3. HARNESSES - SECURE
4. LOOSE ITEMS - SECURE
5. WINDOWS/VENTS - CLOSED
6. CLEAR BELOW

TYPE	ENTRY		RECOVERY
1G PHASE A STALL	5° NOSE HIGH 50 KIAS		NEUTRAL
1G PHASE B STALL RIGHT RUDDER	5° NOSE HIGH 50 KIAS (1 SEC)		NASA NEUTRAL
1G RIGHT RUDDER (IP DEMO)	5° NOSE HIGH 50 KIAS 2 TURNS		FLT MAN
1G LEFT RUDDER	5° NOSE HIGH 50 KIAS 3 TURNS		NASA STANDARD
			
			

CHECKLISTS

BEFORE TAKEOFF		BEFORE LANDING	
1. ALTIMETER	5. CANOPY	1. TRAFFIC	4. GEAR
2. BELTS	6. DIVE BRAKES	2. WINDS	5. SPOILER
3. CONTROLS	7. WIND	3. RUNWAY	6. SPEED
4. CABLE	8. EMERGENCIES		

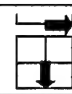
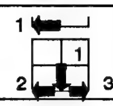
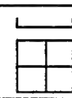
ASK-21 GLIDER SPIN MISSION 3 - 16" CG

FCP WEIGHT	RCP WEIGHT	COCKPIT WEIGHTS	TAIL WEIGHTS

ALTITUDES (MTN VALLEY)		AIRSPEEDS	
MIN SPIN ENTRY:	6700' MSL	MIN SINK	45 KIAS
FLT MAN REC:	6200' MSL	L/D MAX	56 KIAS
WINGS LEVEL:	5700' MSL	Vmax	108 KIAS

PRE-SPIN CHECKLIST

1. TRIM - NEUTRAL
2. DIVE BRAKES - CLOSED/LOCKED
3. HARNESSES - SECURE
4. LOOSE ITEMS - SECURE
5. WINDOWS/VENTS - CLOSED
6. CLEAR BELOW

TYPE	ENTRY		RECOVERY
1G PHASE C STALL RIGHT RUDDER	5° NOSE HIGH 50 KIAS (3 SEC)		NASA NEUTRAL
1G RIGHT RUDDER	5° NOSE HIGH 50 KIAS 2 TURNS		NASA MODIFIED
1G LEFT RUDDER W/ AIL EFFECTS	5° NOSE HIGH 50 KIAS 3 TURNS		FLT MAN
			
			
			

CHECKLISTS

BEFORE TAKEOFF

1. ALTIMETER
2. BELTS
3. CONTROLS
4. CABLE
5. CANOPY
6. DIVE BRAKES
7. WIND
8. EMERGENCIES

BEFORE LANDING

1. TRAFFIC
2. WINDS
3. RUNWAY
4. GEAR
5. SPOILER
6. SPEED

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SPIN DEMONSTRATION/DATA (P/FTE/N)

REFERENCES:

1. Flying Qualities Textbook, Chapters 9 & 10
2. MIL-STD-1797A
3. MIL-F-83691B
4. T-2C NATOPS Flight Manual

PURPOSE:

1. To evaluate the departure/spin susceptibility and spin modes of the T-2C.
2. To increase one's ability to observe and record high AOA flight test data.
3. To correlate theory with actual aircraft motions.

AIRCRAFT:

T-2C (no external stores; equipped with instrumentation system)

MISSION SUMMARY:

1. Each pilot will fly a spin demonstration sortie and a spin data sortie. Each FTE/N will fly a spin demonstration sortie on which data will be collected. The types of spins to be flown on each sortie are listed below. Detailed descriptions of each stall/spin and recoveries are given in the MISSION EVENTS section. Flight cards are available in the Operations area. When the direction of control inputs and type of recovery are not specified, the student may choose the spin inputs and recovery type required for data purposes.

2. Spin Demo (Pilots/FTE/Ns)
   a. Phase A, B and C Stalls/Neutral Recovery
   b. Phase D Stall (post-stall gyrations)/Neutral Recovery
   c. Baseline Upright Spin/NATOPS Recovery
   d. Inverted Spin/NATOPS (Neutral) Recovery
   e. Elevator Effects/Full Aft Stick Recovery
   f. Aileron Effects/Full Aft Stick w/Aileron Into Recovery
   g. Control Float (prolonged post-stall gyrations)/Hands-off Recovery
   h. Inertial Coupled Departure/Neutral Recovery
   i. Data Demo (Baseline Upright Spin)/NATOPS Recovery

3. Spin Data (Pilots)

Any spins not accomplished on the spin demo mission WILL be completed followed by data spins emphasizing the assigned area of interest per Spin Exercise Letter (student handout). Plan on completing eight spins on the data ride.

LIMITATIONS:

1. Comply with the following limitations during the mission:

a. Complete the spin checklist to include a FOD check before all Phase B, Phase C stalls and all spins.

b. Accomplish Phase B, Phase C stalls and all spins in a designated spin area.

c. Only approved stalls and spins will be flown (if in doubt, check with spin IP).

d. Hold alternate recovery techniques for no more than two turns; if not recovered after two turns, apply the NATOPS recovery.

e. Apply recovery controls by 20,000 ft MSL.

f. If still spinning at 18,000 ft MSL (15,000 ft AGL), the instructor takes control and performs a NATOPS recovery.

g. Eject if still out-of-control at 10,000 ft MSL (7,000 ft AGL).

2. Pertinent aircraft limitations are:

a. Accelerations: +5.6g (tip tanks dry); -1.5g inverted spin; < 0g (60 sec limit); 0g (30 sec limit).

b. Rudder deflections: 160 KIAS max for full deflection; < ½ pedal above 160 KIAS.

c. A maximum of four negative g maneuvers may be performed on any flight due to venting from the engine oil system (includes inverted spins and coupled departures).

3. At least one of the following is desired for spin missions:

a. SPORT instrumentation radar to include flight vision.

b. Real-time telemetry to one of the USAF TPS ground stations. A student FTE/N and/or pilot may be scheduled in the telemetry room and may participate in the briefing, mission and debriefing.

c. Chase aircraft, if flown, should have radio and visual contact with the spin aircraft. The condition of the spin aircraft should be visually checked by chase after the Phase C stall and all spins. Chase procedures are defined in Section V.

4. Cassette recorders will not be carried on spin missions to prevent FOD in the cockpit.

MISSION EVENTS:

1. Mission Preparation.

The student will have a thorough understanding of the mission sequence, the entries, spins and recoveries to be used during the mission. Pre-printed spin profile cards are available for the student.

2. Briefing.

The IP will brief the flight profile for the demonstration sorties and include test techniques and data taking techniques. The pilot will brief the spin data sortie. Airstart procedures will be briefed.

3. Ground Procedures.

Check that the pre-spin maintenance inspection has been signed off (required for inverted spins). A thorough preflight will be performed with special emphasis on inspection of panels, rivets and fasteners. Perform an EAR check and practice control inputs prior to taxi. Contact SPORT, if required, during taxi out when abeam the tower.

4. Takeoff.

An airborne pickup will be performed if a chase is scheduled. The T-2 will accelerate to and climb at 300 KIAS until completion of the safety check.

5. Climb.

After chase joinup and safety checks are complete, clear wingman to safety chase (if applicable) and zoom to continue climb at 250 KIAS. Local altimeter setting (QNH) will be maintained throughout the mission. Accomplish an airborne SI check with the control room. Obtain altitude checks with SPORT, TM and chase when passing 10,000 ft and 18,000 ft MSL.

6. Phase A Stall (lg).

This phase investigates stall characteristics using normal control techniques. The Phase A stall should be entered from an initial trim speed of 150 KIAS above 18,000 ft MSL. Select idle thrust and establish a 1 kt/sec bleed rate using pitch control. The student should make appropriate comments covering such items as bleed rate, altitude, pitch attitude, type of stall warning and stall airspeed AOA. The aircraft should be recovered at the first positive indication of stall. At the stall, immediately neutralize all controls, evaluate aircraft response, then to return to level flight adding power only after the stall is broken while maintaining AOA <17.5 units or buffet-free flight. Repeat the maneuver except use a 5 kt/sec bleed rate to demonstrate dynamic effects. The high decel rate entry will require higher initial speed and pitch attitude (but same trim setting) to bleed off the speed at near lg flight.

7. Phase A Stall (2g & WUT).

Accelerated stall entries will be performed starting with thrust for level flight (TLF) at 200 KIAS (constant 2g decel) or 160 KIAS (windup turn) above 18,000 ft MSL. Use a bleed rate of 3 kt/sec for the 2g decel and AOA bleed rates of 1 unit/sec and 5 units/sec for the windup turns. Student comments, stall recovery, etc are identical to that listed for the Phase A Stall (lg) above.

8. Accomplish Pre-Spin Checklist.

The pre-spin checklist can be found at the end of the section.

NOTE

Turning anti-collision light off prevents failure of electric motor in top of anti-collision light during spins.

NOTE

Selecting tip tank transfer maintains positive bleed air pressure in tip tanks and prevents fuel flowing back into empty tip tanks during spins.

9. Phase B Stall (lg).

This phase investigates the effects of misapplied controls at the stall, either intentionally or in response to unscheduled aircraft motions. Prior to the Phase B stall, complete the pre-spin checklist listed above. Perform a negative g FOD check by rolling inverted and slowly applying forward stick. Check for loose items and tightness of the restraint system. Complete the Phase B stall in the spin area. Enter the Phase B stall from a 230 KIAS climb with pitch attitude of 5-15 degrees above the horizon. Retard the throttles to idle passing about 24,000 ft MSL and set throttle friction. Hold the nose up through the rudder shaker and initial buffet. At the stall, apply full cross controls (full left rudder with full right and aft stick) and hold for one second. After these pro-spin controls have been held for one second, neutralize the controls. Recover to level flight using a MIL power pull at 17 units maximum or buffet-free flight. During the recovery, be aware of secondary stalls. Make appropriate comments leading up to the stall, post-stall gyrations, etc and assess the aircraft's susceptibility to departure.

10. Phase C Stall.

This phase investigates the effects of prolonged misapplication of controls. The Phase C stall will be conducted in the spin area. Entry conditions (full cross controls) are the same as the Phase B stall, except hold the inputs for three seconds. At the end of three seconds, neutralize the controls and observe the aircraft response. Recover to level flight using a MIL power pull at 17 units maximum or buffet-free flight.

11. Phase D Stall (Post-Stall Gyrations).

The Phase D stall involves deliberate spin attempts. Misapplied controls are normally held for various lengths of time or for a specified number of turns (nominally 15 seconds or three spin turns, but may be held longer for this demo). This event demos an oscillatory post-stall motion. The Phase D entry conditions are the same as the Phase B and Phase C stalls. At the stall, apply and hold full left rudder and full left and aft stick. Watch inadvertently activating the trim while holding the controls. Note the aircraft's response to these controls, particularly any oscillations or hesitations as the maneuver progresses. Prior to 160 KIAS - usually about three turns - neutralize the controls and recover the aircraft.

12. Baseline Upright Spin/NATOPS Recovery.

This maneuver demonstrates the developed spin and NATOPS recovery characteristics. It also provides baseline spin data for subsequent investigations of control effects in both the developed spin and recovery phases. From the standard entry (see Phase B and Phase C stalls), apply and hold full crossed controls with full aft stick. Note AOA, attitude, turn needle, airspeed, oscillations, etc while in the spin and verify that roll and yaw are in the same direction. At the instructor's command apply NATOPS recovery controls - neutralize controls, then full opposite rudder. Neutralize the rudder as rotation stops and recover the aircraft.

13. Inverted Spin/NATOPS (Neutral) Recovery (IP Demo).

The instructor will demonstrate the entry from a wings level, 45 degrees nose high inverted stall. Enter from 250 KIAS and 45 degrees pitch attitude above 23,000 ft MSL. At 160 KIAS, roll inverted and, as the nose approaches the horizon at 100 KIAS, crossed controls and full forward stick will be applied and held. Note the cockpit indications (AOA, turn needle, airspeed) of an inverted spin and verify roll and yaw are in opposite directions. During negative g flight the forward part of the seat pan may lift slightly. Recover the aircraft prior to reaching -1.5g using a NATOPS (neutral) recovery.

14. Elevator Effects/Full Aft Stick Recovery.

This maneuver demonstrates the effect of pitch control both during the spin and also in the recovery. From the standard entry, apply and hold full crossed controls with full aft stick. After the spin stabilizes, slowly push the stick forward while maintaining full out-spin (out=opposite direction of spin, in=same direction of spin) aileron. Note the effect of the elevator during the developed spin. Hold the stick momentarily at about the neutral position, then rapidly return it to full aft. When the spin restabilizes, and at the instructor's command, apply NATOPS recovery controls, except use full aft stick -- neutral ailerons, aft stick, then full opposite rudder. As rotation stops, neutralize the controls and recover the aircraft. Watch for tendencies to

reenter a spin in the opposite direction. Compare the full aft stick recovery characteristics to the NATOPS recovery.

15. Aileron Effects/Aileron Into w/Full Aft Stick Recovery.
This maneuver demonstrates the effect of lateral control both during the spin and also in the recovery. From the standard entry, apply and hold full crossed controls with full aft stick. After the spin stabilizes, move the stick slowly across to the full in-spin direction while maintaining full aft stick then rapidly return the stick to the full out-spin direction. Note the effects of lateral control position during the spin. When the spin restabilizes, and at the instructor's command, apply full in-spin lateral control with full aft stick and full opposite rudder. As rotation stops, neutralize the controls and recover the aircraft. Compare this recovery with the full aft stick recovery and NATOPS recovery.

16. Control Float (Post-Stall Gyrations)/Hands-Off Recovery.
This maneuver demonstrates the float tendencies of reversible controls during a spin and a hands-off recovery. A vertical entry will be used to demonstrate prolonged PSG. Begin a 3g pull to the vertical from around 21,000 ft MSL and 300 KIAS. As the nose reaches the vertical, stop the pitch rate; passing 160 KIAS apply full left, then right, then left again rudder inputs (a triplet), roughly in phase with the Dutch roll. On the final left rudder input, apply full right and aft stick. Hold these controls through the PSG into the spin. After the spin stabilizes, and at the instructor's command, release the controls. Note the position of the rudder pedals and the longitudinal stick. Monitor the control positions throughout the recovery. An abrupt pitchover is common as the rotation stops. When the aircraft begins to tuck, neutralize the controls. If no recovery is indicated by 20,000 ft MSL, apply NATOPS recovery controls. After recovery, comment on the PSG, restraint system, and float characteristics of the rudder and elevator as indicated by the pedals and stick. Compare the hands-off recovery to the previous recoveries.

17. Inertia-Coupled Departure/Neutral Recovery.
The instructor will demonstrate this maneuver first, followed by the student. Set up the vertical entry as was done for the Control Float demo above. With the nose straight-up, passing 200 KIAS, apply full right stick. After about 2 seconds, apply full right rudder at a moderate rate (below 160 KIAS at full deflection). After another 2 seconds, push the stick to full forward (still full right) and shift the rudder to full left. After the motion subsides, neutralize the controls. This technique usually produces a disorienting tumbling motion that persists for several turns. Note the apparent strength of the inertial coupling and physiological effects of the motions.

18. Data Event Demo (Baseline Upright Spin)/NATOPS Recovery (IP Demo).
This maneuver demonstrates data gathering and recording techniques in a steady, baseline upright spin. From the standard spin entry, the instructor will apply full crossed controls with full aft stick. When the spin steadies, the instructor will call "mark" on a prominent geographic reference point. Simultaneously, begin timing and call out altitude. During the following three turns, call out steady airspeed and estimates of pitch and wing tilt angles. At the end of the third turn, simultaneously mark the time and altitude, and apply NATOPS recovery controls. Record the altitude at the bottom of the pullout to get total altitude loss for the recovery.

19. Recovery Notes.
Apply recovery controls by 20,000 ft MSL. If not recovered by 18,000 ft MSL, the IP will take control of the aircraft and perform a NATOPS recovery. During recoveries from spins, neutralize controls as (not "when") rotation stops. After rotation stops, airspeed should be 130-180 KIAS and pitch attitude may be steep. Allow airspeed to increase and verify controls are free by wiggling the stick. After airspeed increases to about 180 KIAS, begin a wings-level pull to about 3g; don't exceed 17 units AOA. Normal minimum for bottom out is 15,000 ft MSL. Use outside references for wings level since the attitude gyro may not be correct following a spin. Slowly advance the throttles when the nose passes the horizon and check engine instruments. Establish a 230 KIAS climb while turning outbound to set up for the next spin. Keep an eye on the fuel quantity. Transfer wing fuel during the climb between events, as required. Remember to select TIP TRANSFER prior to the next maneuver.

20. Return to Base.
After the last maneuver, turn engine anti-ice to OFF (below 20,000 ft MSL), position anti-collision lights to STROBE, and select fuel transfer to OFF (if tip tanks are empty). When wings-level, align the compass, erect the standby gyro, and use FAST ERECT for the attitude gyro. Prior to passing 9,000 ft MSL, pull the dump handle to verify the tip tanks are dry, then restow the handle.

21. Pattern and Landing.
The pilot will accomplish a simulated flameout landing (SFO) with chase. Fuel permitting, a normal, simulated single engine or no-flap pattern may be flown. If the chase aircraft does not have sufficient fuel to chase a SFO, chase may split up on RTB and enter the pattern from initial or straight-in.

22. Debriefing.
Every available aid should be used during the debriefing to include TM strip charts and video tapes of the spins, if available.

INSTRUMENTATION:

Telemetry room monitoring and on-board instrumentation.

DATA REDUCTION:

See Spin Exercise Letter for specific data requirements to be presented. Students should be able to discuss the effects taught in the high AOA course and show important points on strip charts during post-flight debrief.

REQUIRED REPORTS:

See Spin Exercise Letter for details.

T - 2 SPIN DEMO

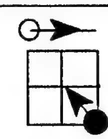
C/S	A/C	OPS #	FREQ
			AREA
TOLD			T/O TIME

Phase A : Normal inputs;
recover at first indication of stall/departure

EVENT	ENTRY	RECOVERY
1g Decel 1 kt/sec 5 kt/sec	≥ 18,000 ft V_{trim} : 150 kt Idle	NATOPS Release pull F_s ; ≤17-1/2 AOA or buffet free; increase power
2g Decel ~3 kt/sec	V_{trim} : 200 kt TLF	
Windup Turn 1 unit/sec 5 units sec	V_{trim} : 160 kt TLF	

*** COMPLETE PRE-SPIN CHECKLIST before proceeding ***

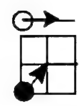
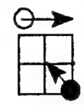
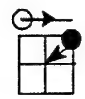
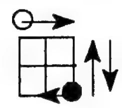
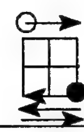
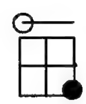
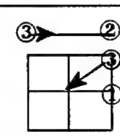
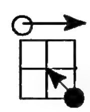
Phase B : Brief control misapplication at stall:
recover after 1 second

EVENT	ENTRY	CONTROLS
1g Decel	≥ 26,000 ft V_{trim} : 150 kt Idle	

Phase C : Prolonged control misapplication at stall;
recover after 3 seconds

REPEAT PREVIOUS EVENT WITH 3-SEC MISAPPLICATION

Phase D : Intentional departure/spin attempts;
recover after 15 seconds, or 3 turns

EVENT	ENTRY	CONTROLS
Oscillatory	≥26,000 ft V_{trim} : 150 kt Idle 1g decel	 Watch 160 kt rudder limit
Non-oscil baseline	≥26,000 ft V_{trim} : 150 kt Idle 1g decel	 NATOPS controls
Inverted	≥23,000 ft 250 kt: 45NU 160 kt: roll inv 100 kt: controls	 Lower seat -1.5g Max
Elevator effects	≥26,000 ft V_{trim} : 150 kt Idle 1g decel	 If no rec after 2 turns, NATOPS
Aileron effects	≥26,000 ft V_{trim}: 150 kt Idle 1g decel	 If no rec after 2 turns, NATOPS
Control float	≥ 21,000 ft 280 kt: pull 90 NU 160 kt: Rud triplet	 **Release Controls If no rec after 2 turns, NATOPS**
Coupled departure	≥21000 ft 300 kt: pull 90 NU 200 kt: ① 160 kt: ②,then ③	 Lower seat
Data demo	≥26,000 ft V_{trim} : 150 kt Idle 1g decel	 Handheld data ▲t, ▲Hp / turn, turns, ▲Hp / rec

** COMPLETE POST-SPIN CHECKLIST **
(area / strobes / gyros / anti-ice < 20,000 ft)

T - 2 SPIN DATA

C/S	A/C	OPS #	FREQ
			AREA
TOLD			T/O TIME

Phase A : Normal inputs;
recover at first indication of stall/departure

EVENT	ENTRY	RECOVERY
1g Decel 1 kt/sec 5 kt/sec	≥ 18,000 ft V_{trim} : 150 kt Idle	NATOPS Release pull F_s ; ≤17-1/2 AOA or buffet free; increase power
2g Decel ~3 kt/sec	V_{trim} : 200 kt TLF	
Windup Turn 1 unit/sec 5 units sec	V_{trim} : 160 kt TLF	

*** COMPLETE PRE-SPIN CHECKLIST before proceeding ***

Phase B : Brief control misapplication at stall:
recover after 1 second

EVENT	ENTRY	CONTROLS
1g Decel	≥ 26,000 ft V_{trim} : 150 kt Idle	

Phase C : Prolonged control misapplication at stall;
recover after 3 seconds

REPEAT PREVIOUS EVENT WITH 3-SEC MISAPPLICATION

Phase D : **Intentional departure/spin attempts; recover after 15 seconds, or 3 turns**

EVENT	ENTRY	CONTROLS

** COMPLETE POST-SPIN CHECKLIST **
(area / strobes / gyros / anti-ice <20,000 ft)

T-2 PRE-SPIN CHECKLIST

Brief SPORT

Hot mike
Stow loose gear
Lap belts - Tight
Visor - Down/tight
Rudder pedals - Adjust aft
Shoulder harness - Lock
LG/flaps/SB - Up/in
Battery - Norm
Yaw damper - Off
Anti-ice - On
Anti-collison light - Off
Turn needle/AS/AOA - Check
PCL Idle Stop - Up
Dump tip fuel
Fuel trans - Tips
Friction - On
Note neutral stick position
FOD check
Throttles - Idle
Trim - Set

T-2 POST- SPIN CHECKLIST

Area - Deactivate
Anti-ice - Off (<20,000/ MSL)
Anti-collision light - Strobe
Att Gyro - FAST ERECT
Compass - REALIGN
Fuel trans - Off (if wing tanks empty)
Dump tip fuel (>9000/ MSL)

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F-16 DEPARTURE DEMO (P/FTE/N)

REFERENCES:

1. Flying Qualities Textbook, Chapter 10
2. MIL-STD-1797A
3. MIL-F-83691B
4. F-16A/B Flight Manual, Chapters 3 and 6
5. F-16 Departure Briefing Guide

PURPOSE:

To qualitatively evaluate F-16B handling qualities in the High Angle-of-Attack departure, deep stall, and recovery phases of flight.

AIRCRAFT:

F-16B

GENERAL:

1. This mission is designed as an introduction to High Angle-of-Attack (Hi AOA) handling qualities, departure characteristics, deep stalls, and recoveries. This is in contrast to the T-2 spin missions which are primarily concerned with steady-state spin modes and the investigation of optimum recovery techniques. Primary emphasis during this mission will be to evaluate and observe aircraft control effectiveness and handling qualities at Hi AOA during deep stall conditions and recoveries.

2. One demonstration sortie will be flown by pilots, and aircraft availability permitting by navigators/engineers. Each student will fly the profile outlined under Mission Events, Section 7, Departure Profile.

3. Phase I maneuvers represent those maneuvers designed to investigate departure boundaries while Phase II maneuvers are, by definition, intentional departures. Phase I maneuvers are comparable to Phase A/B/C stalls while Phase II maneuvers are comparable to Phase D stalls. The terms "Phase I/II" are commonly used when conducting F-16 Hi AOA tests at the AFFTC (Contrast-not to be confused with HQ testing terminology).

LIMITATIONS:

1. Ground Training:

a. Prior to flying this mission, the student will have successfully completed the USAFTPS Spin Training Program, and will have previously flown the F-16 during the USAFTPS curriculum.

b. All students will have received a briefing on F-16 handling qualities in the Hi AOA flight regime.

2. Flight Restrictions:

a. All departure missions will be flown in an F-16B with a departure qualified instructor pilot.

b. To minimize FOD in the cockpit, only essential items will be carried (i.e. no cassette recorders, stopwatches, cameras, etc.).

c. All departures will be conducted in an appropriate spin area at or above 35,000 feet MSL in the cruise configuration. Fuel will be balanced to attain a C.G. of 38% for small horizontal tail F-16's and 41% for large horizontal tail F-16's.

d. For Phase II intentional departures, power will be set to IDLE passing through 30° or prior to airspeed decreasing below 200 KIAS. For Phase I departure boundary maneuvers, power will be set to MIL prior to executing the maneuver.

e. Aircraft will only be flown in a clean or centerline tank configuration with or without symmetric AIM-9 missiles at stations 1 and 9 (i.e. two or none). A "clean" aircraft may have a centerline pylon. A centerline tank, if installed, will be verified empty prior to performing any deep stall maneuvers.

f. The aircraft will have a current Weight and Balance form along with an appropriate fuel burn curve for the desired C.G.

g. Any unusual control response, unexpected aircraft motions, structural damage, or engine response which is noted at any time will be cause to terminate the mission and land from an appropriate pattern.

h. A dedicated mission frequency will be used.

i. Proper C.G. position will be verified prior to each departure/maneuver.

j. There must be a discernible horizon with sufficient ground references to glide to high key for a suitable runway. A minimum of one suitable YELLOW lakebed runway is required for all sorties in which a student occupies the front cockpit. Based on the student's previous experience, the YELLOW lakebed requirement may be waived at the discretion of the USAFTPS Operations Officer. If a qualified (current AF Form 8 checkride defining "qualified") F-16 pilot

occupies the front seat, the sortie may be flown using the main runway whether a lakebed runway is available or not.

MISSION EVENTS:

1. Mission Preparation.

The student will have a thorough understanding of the mission sequence, entries, and recovery procedures to be used during the mission. Aircraft flight characteristics and engine airstart procedures will be reviewed in chapters 6 and 3 of the flight manual, respectively. Departure profile cards are available in operations.

2. Briefing.

The IP will brief the mission.

3. Ground Procedures.

The following procedures are unique to the departure mission:

a. Brief SPORT concerning spin area, number and type of departures and mission frequency.

b. Ensure the stick control switch corresponds to the instructor's cockpit position, and both cockpits perform flight control checks.

c. Ensure all loose equipment has been removed from the cockpit. Do not carry a cassette recorder, camera, stopwatch, etc.

d. Ensure a video tape is loaded in the aircraft.

e. Ensure aircraft is loaded with symmetric wing tip missiles (i.e. one at stations 1 and 9 or none at all).

f. Perform a BUC start to ensure operation of back-up fuel controller, and familiarize the student with BUC airstart throttle movements.

4. Takeoff.

If flown with a chase, an airborne pickup will be performed. Chase will accomplish a "clean and dry" check and then assume a safety chase position. If flown single-ship accomplish a normal MIL power takeoff.

5. Climb.

During climb out complete the following checks:

a. -1 G FOD check.

b. Ensure Starting Fuel Switch is in LEAN.

c. Ensure the Stores Configuration Switch is in CAT I.

d. Ensure internal wings have gone dry. The departure sortie will NOT be flown with any fuel trapped fuel in the internal wings. Feed forward/aft fuel as necessary to obtain the desired C.G.

e. UHF Guard/VHF may be turned off, if desired.

6. Pre-Departure Checks.

Prior to each maneuver you will reconfirm your C.G. and feed fuel as necessary to maintain it as desired. Attempt to be established on your setup parameters at 5 NM and ensure the shoulder harness is locked and the fuel feed switch is in NORM.

NOTE

Locking the shoulder harness may physically hinder some individuals from reaching the MPO switch, particularly during inverted departures. If this is the case, the shoulder harness should not be locked, but ensure the lap belt is securely fastened.

At 3 NM, ensure the data/video recorder is on, and state which maneuver you will be performing. At 1 NM you may begin a zoom maneuver as needed (distances are from center of spin area).

7. Departure Profile.

When attempting intentional departures (Phase II) it may be necessary for the instructor pilot to MPO assist the aircraft into the deep stall. The student will perform the maneuver exactly as described; however, following the departure the instructor may have to override the aircraft's tendency to self recover by engaging the MPO and flying the aircraft into a deep stalled condition. This action will be transparent to the student.

a. Instructor Demonstration of 1 G AOA Roll, Maximum G Roll, and Erect 60° Departure. The instructor will demonstrate the procedures and techniques for performing these three maneuvers. This will allow for optimum use of fuel while waiting for the wing tanks to go dry, and provide the student with a feel for the timing of the departure pattern and checks. Following the instructor's demonstration, the student will perform maneuvers b through I. Sufficient fuel will remain following this to repeat additional maneuvers at the student/instructor's option. Maneuver descriptions are contained in the following paragraphs.

b. 1 G AOA Rolls (Phase I)

Purpose: This roll demonstrates a typical Phase I maneuver used to determine aircraft handling restrictions such as bank angle limits or stick movement restrictions (i.e. abrupt or smooth inputs). This maneuver "assaults" the limiter in one axis.

Maneuver: Plan to arrive in the spin area wings level established on the AOA limiter (approximately 105 KIAS) at 35,000 feet (-500 ft, +2000 ft). One technique is to climb to 36,000 -

37,000 ft, and slow to the limiter 1 - 2 NM prior to the spin area. The extra altitude along with power may then be used to control the aircraft descent so as to arrive on conditions in the spin area. Once in the spin area establish MIL power and allow the engine to stabilize (5 secs), abruptly apply full lateral stick with feet on the floor and hold. Allow aircraft to roll through 360° while maintaining full aft longitudinal stick force and full lateral stick force. Release the stick at 360° bank angle change, and allow 2-3 seconds of free aircraft response prior to resuming aircraft control. During the maneuver note the flight control computer's (FLCS) ability to control the AOA.

c. Maximum G Rolls (Phase I)

Purpose: This maneuver is similar to the 1 G AOA roll in purpose; however, it is designed to "assault" two limiters at the same time.

Maneuver: Establish 300 KIAS/35K at 5 NM. Upon entering the spin area set MIL power and allow the engine to stabilize, pull the nose 5° above the horizon, roll to 90° of bank and as the nose falls to the horizon ABRUPTLY apply full aft stick with no lateral stick, and establish the aircraft on the AOA limiter (25.5°). The airspeed will begin to bleed off, at 250 KIAS established on the limiter, ABRUPTLY apply full lateral stick for a roll over the top while maintaining full aft stick and feet on the floor. During the maneuver note the FLCS ability to control the AOA. Release the stick at 360° of bank angle change.

d. AOA Excursion (Phase I)

Purpose: This maneuver is designed to show the pitch limiter of the F-16 flight control system can be exceeded; however, momentarily exceeding the AOA limiter does not mean it will depart or enter a deep stalled condition.

Maneuver: Establish 375 KIAS/27K at 5 NM. At 1 NM begin a smooth pull up to 70° pitch attitude, select IDLE passing through 30° or prior to reaching 200 KIAS, when airspeed decreases through 175 KTS, roll 180°, stop the roll and ABRUPTLY apply full aft stick and hold. During the zoom at 70° nose high the FLCS will attempt to increase the pitch attitude, so forward stick pressure must be maintained to prevent this. During the maneuver note the FLCS ability to control the AOA. Perform a dive recovery after 200 KIAS.

e. Erect 60° Departure (Phase II)

Purpose: This maneuver demonstrates an intentional erect departure with subsequent self-recovery or entry into a deep stalled condition.

Maneuver: Establish 375 KIAS/27K at 5 NM. At 1 NM begin a smooth pull up to 60° pitch attitude, select IDLE passing through 30° or prior to reaching 200 KTS, maintain zero pitch rate (i.e. maintain 60° nose high). During the zoom at 60° the FLCS will attempt to increase the pitch attitude, so forward stick pressure will be required until airspeed is below 50 KIAS at

which time a smooth transition to full aft stick will be required. During the maneuver note the FLCS ability to control the AOA. Release the controls after departure.

f. Inverted 60° Departure (Phase II)

Purpose: This maneuver demonstrates an intentional inverted departure and subsequent self-recovery or entry into a deep stalled condition.

Maneuver: Establish 375 KIAS/27K at 5 NM. At 1 NM begin a smooth pull up to 70° pitch attitude, select IDLE passing through 30° or prior to reaching 200 KIAS; at 200 KIAS roll inverted and apply forward stick to maintain 60° inverted. An alternate setup may be performed by delaying 2-3 seconds after reaching the center of the spin area, then initiating a smooth pull up as if you are performing a loop; continue this pull until achieving a 60° nose high INVERTED pitch attitude. Forward stick pressure will be required to hold 60° inverted. During the maneuver note the FLCS ability to control the AOA. Release the controls after departure.

g. Pitch Rate Departure (Phase II)

Purpose: This maneuver demonstrates if the pitch limiter is exceeded in an aggressive and sustained way the F-16 will more than likely depart controlled flight, and may subsequently enter a deep stall.

Maneuver: Establish 375 KIAS/27K at 5 NM. At 1 NM begin a smooth pull up to 80° pitch attitude, select IDLE passing through 30° or prior to reaching 200 KIAS, and when airspeed decreases through 125 KIAS, roll 180°, stop the roll and ABRUPTLY apply full aft stick and hold. During the zoom at 80° nose high the FLCS will attempt to increase the pitch attitude, so forward stick pressure must be maintained to prevent this. During the maneuver note the FLCS ability to control the AOA. Release the controls after departure.

h. Tactical Pitch Rate Departure (Phase II)

Purpose: This maneuver demonstrates a more realistic tactical scenario where, if the pitch limiter is exceeded in an aggressive and sustained manner, the F-16 will more than likely depart controlled flight, and may subsequently enter a deep stall.

Maneuver: Establish 375 KIAS/27K at 5 NM. At 1 NM pull up to 70° pitch attitude, and select IDLE passing through 30° or prior to 200 KIAS. When the low-speed warning horn sounds, moderately apply full aft stick. Continue a symmetric pull over the top until departure occurs. Release the controls after departure.

i. Roll Coupled Departures (Phase II)

NOTE

The potential for engine anomalies is increased when performing roll coupled departures due to the disrupted airflow. The detuned status of all Edwards AFB F-16 PW-200 engines minimizes this potential, however.

Purpose: This maneuver demonstrates coupling effects between pitch, roll, and yaw at different energy levels during departure and subsequent self-recovery or entry into a deep stalled condition.

Maneuver: Establish 350 KIAS/25K at 5 NM. At 1 NM smoothly pull up to 60° pitch attitude, select IDLE passing through 30° or prior to 200 KIAS, at 135 KIAS ABRUPTLY apply simultaneous full left aileron, full forward stick, and full left rudder. Maintain these control inputs until 270° of bank angle change, and then ABRUPTLY apply full aft stick while maintaining full left stick and rudder. Release controls after departure.

8. Recoveries.

The pilot will attempt to recover the aircraft in accordance with the flight manual until 28,000 feet MSL. If at this time a recovery is not imminent, the instructor will assume aircraft control and recover the aircraft. If the aircraft is not recovered by 25,000 feet MSL, the instructor at his option may select: 1) speed brakes, and if erect the following: 2) aft feed, 3) alternate flaps, 4) MAX afterburner and stores jettison (if applicable). Pitch rocking will be continued until 13,000 feet MSL at which time a bailout from the aircraft will be made.

After recovery check engine instruments; if any anomaly is noted, immediately point towards Edwards and prepare for the appropriate emergency pattern. If a compressor stall occurred during the departure, but the engine has self-recovered, set the throttle to 80% and cycle the EEC from ON to OFF and back to ON. Be careful not to cycle the switch into BUC. If the stall/stagnation caused engine RPM to decrease enough to activate the Emergency Power Unit (EPU), abort the mission, RTB, and refer to the checklist. Otherwise, turn the data/video recorder off, and reset any warning lights according to Figure 4.1. Recheck your C.G. and set up for the next maneuver. Maneuvers may be repeated as necessary. Maneuvers may be flown at any C.G. equal to or forward of the designated aft C.G., and aft of the forward C.G. limit listed on the Weight and Balance form.

"AFTER RECOVERY" LIGHTS PROCEDURES	
LIGHTS ILLUMINATED AFTER DEPARTURE	PILOT ACTION
W/OUT DUAL FC	
- ADC - CADC - LE FLAPS - P, R, and/or Y Lts	ELEC RESET
- SERVO Lts	SERVO RESET
WITH DUAL FC	
- ADC - CADC - LE FLAPS	ELEC RESET
- SERVO Lts	ELEC RESET .... if DUAL FC Lt goes out then SERVO RESET
- P, R, and/or Y Lts	REFER TO CHECKLIST (declare IFE and RTB)

FIGURE 4.1

NOTE

Unless stated otherwise in the figure above the mission may be continued once all lights are reset.

9. Departure Pattern.

Departures may be accomplished in any of the spin areas. A race track pattern similar to that flown during the T-2 spin rides works well. Following recovery from a maneuver a MIL power, 300 - 350 KIAS, climb outbound to 5 NM, and then an easy turn back to the spin area will achieve the desired setup parameters at 5 NM inbound. As you become familiar with the pacing and energy permitting you may begin to shorten the outbound leg, if desired.

10. RTB.

During RTB, balance the fuel as necessary to get back within normal operating limits. Return the Start Fuel Switch to AUTO LEAN. Perform a normal descent check.

11. Pattern and Landings.

RTB to high key for an SFO full stop.

12. Debriefing.

Using aircraft video tape, student and instructor will discuss F-16 departure, deep stall, and recovery characteristics.

13. Airstart Procedures.

Due to unpredictable airflow during a deep stall, there is an increased chance of engine stagnation requiring the engine to be shutdown and restarted. The rear cockpit of the F-16B is incapable of performing an airstart. As such the front cockpit crewmember must be prepared to perform all the necessary airstart procedures in a worst case intercom out situation. The following is a brief description/timeline of the steps which will be necessary. At first indication of a possible engine stagnation during a deep stall the aircraft should be immediately recovered to controlled flight and pointed toward high key. Assuming a stagnation has occurred the throttle should be positioned to OFF, and the EPU confirmed ON (green run light). If the EPU has not automatically started, it should be turned ON with the EPU switch. RPM will decrease rapidly and the primary concern is to return the throttle to IDLE within the start envelop of 25% - 40% RPM and FTIT < 700° C. THIS IS THE PRIMARY CONCERN. Workload permitting, attempt to achieve 300-350 KIAS in a 30° dive until reaching an altitude of 20,000 ft, at which time the descent rate should be decreased to achieve a glide speed of 250 KIAS, and JFS - START 2 should be selected below 20,000 ft. If the JFS is confirmed running, the airspeed may again be slowed to 210 KIAS for maximum range glide. Continue to monitor the start while heading towards high key. All spin areas are located well within gliding range of the field, and plenty of time will be available to deliberately accomplish the necessary procedures.

INSTRUMENTATION:

1. The aircraft video tape will be the primary data source.

2. NO hand-held gauges, stopwatches, portable tape recorders, cameras, etc. will be carried on this mission.

DATA REDUCTION:

None.

REQUIRED REPORTS:

None.

SECTION V
CHASE PROCEDURES AND TECHNIQUES

REFERENCE:

1. AFSCR 55-7
2. AFFTCR 55-2

DISCUSSION:

1. A large part of the resources used in flight test are devoted to safety and photo chase support. Virtually every test mission flown at Edwards is chased and a proportionately large percentage of the missions flown at other test organizations are also chased depending on the requirements of a particular test program. At the USAF Test Pilot School, the spin missions require a safety chase.

2. This section contains a general discussion of chase procedures and techniques. The objectives of the chase aircraft, in any event, depend on the requirements of the test aircraft. These objectives vary from merely clearing (providing an extra set of eyes) for the test aircraft, to checking for damage or hung stores during weapon release testing, to providing photographic coverage of particular events. Any chase aircraft has some safety chase responsibilities, but if photo coverage is also required, it is usually designated as a Photo Chase. The discussion which follows is for responsibilities and techniques used in Safety Chase. There are sections for additional requirements such as Photo Chase, Takeoff/Landing Chase and Ordnance Delivery Chase. Specific discussion of each formation/chase curriculum mission follows this more general discussion.

SAFETY CHASE:

1. <u>General.</u>

Because safety chase involves a wide variety of tasks which are performed in support of another test aircraft, it is difficult to specify rules and techniques which apply to all situations. However, in the absence of specifically briefed requirements, the safety chase pilot is always responsible for the following:

a. Clearing Lead - The chase is the eyes of the flight while the lead pilot performs maneuvers which require his or her total attention in the cockpit.

b. Observing the Test Aircraft - The chase pilot is the outside observer and as such is the only one in a position to observe abnormal venting of vapors, loose panels, or improper positioning and movement of aircraft surfaces. In the event of unexpected/uncommanded

aircraft motions such as departures, spin, etc., the chase pilot's observation can be of great value, if chase is in position.

c. Location Within the Assigned Airspace - As with clearing the lead aircraft, the chase pilot can also help to keep the flight within the assigned airspace.

d. Not Hindering the Lead Aircraft - The most important, and many times most difficult, task of the safety chase pilot is to accomplish the above requirements without hindering the lead pilot. Unlike any other type of formation, the lead should not have to (and may not be able to) give the wingman any consideration. In the absence of specific requirements which have been briefed to the contrary, the lead pilot must be free to maneuver in any manner without concern for the chase. To accomplish this, a good flight briefing and advanced planning are required.

e. Observing the Chase Aircraft Operating Limitations - The chase pilot seldom has the luxury of flying a chase aircraft capable of matching the test aircraft throughout the flight envelope. The chase pilot must compensate for this with advanced planning and skill. Without a conscious awareness of your aircraft's limitations, it is possible to maneuver into a position that seriously compromises your safety. This is especially true when performing chase duties close to the ground. The chase pilot can become so intent on getting into an excellent position that the aircraft is placed in an unsafe dive angle, airspeed combination. Operation of the chase aircraft beyond published limits can never be justified. A broken or out of gas chase aircraft heading home is of no value to the lead and will probably force termination of the test mission.

2. <u>Pre-Flight.</u>

a. A good safety chase sortie begins with a good flight briefing. The chase pilot should arrive at the briefing armed with information concerning his or her aircraft such as the maintenance status, configuration, and any unusual limitations which may affect the mission. The test aircraft pilot or test conductor should very clearly define the duties and requirements of the chase aircraft. The chase pilot should ensure that the mission requirements are within the capability and limitations of the aircraft and brief any considerations required to successfully accomplish the mission. It is worth reiterating that there is <u>never</u> any justification for exceeding published limits. All parties involved in the test should leave the briefing with a clear understanding of the events which will take place at each point throughout the flight. The chase pilot should either have a copy of the mission cards, or at least have the pertinent mission information written down so that it is usable in flight. Last minute changes should also be briefed even at the expense of delaying the flight.

b. From the flight briefing until takeoff, the chase pilot must adapt the procedures to safely launch the chase without delaying the lead aircraft while at the same time not using excessive amounts of fuel. The chase should monitor the status of the test mission prior to

engine start. The mission frequency can be used for this purpose.

3. Takeoff and Join-Up.

a. Prior to taking the active, the test aircraft should be checked for proper takeoff configuration, loose panels, leaks, etc. Very often one side of the test aircraft can be checked on the taxiway and the other side on the runway. Observe the test aircraft for proper afterburner operation, if planned, and checked for loss of panels or ordnance during the takeoff roll. The chase should normally start its roll a minimum of eight seconds after lead. However, the takeoff interval and sequence may depend on any number of circumstances. If the test aircraft has external stores, the chase aircraft should not begin its takeoff roll until the lead aircraft becomes airborne. If live ordnance is involved, the chase aircraft should take off first. Wake turbulence is often a factor to be considered, particularly if the T-38 is the chase aircraft. The engine plume of the lead aircraft may be visible and is often a good indication of the presence of wake turbulence. If the wind is calm, lifting off at or just after the lead aircraft lift-off point should be avoided. It may be advisable to extend the takeoff run or have the chase aircraft take off first. It should be remembered that wake turbulence is most severe slightly below the lead aircraft flight path and extends outboard of the wingtips.

b. When safely airborne and clear of the field boundaries, radios should be changed to mission frequency. The chase aircraft should commence a join-up, but remain well clear of the lead until radio contact is established on the mission frequency. If briefed, the chase may then join in close formation and inspect the lead aircraft for leaks, loose panels, etc. The top should be checked as well as the sides and bottom. After a quick but thorough check of the lead aircraft, chase should move out to the chase position, inform lead of his or her status, and state that he or she is clear so that lead can continue the mission. If an overshoot is necessary to kill off excess airspeed, it should be made to the outside of a turn after takeoff, thus providing a safe area to maneuver with lead in sight. The overshoot should be made behind and below lead (not directly under) or above if external stores are carried.

4. In-Flight.

Flying safety chase is not the same as flying a formation mission. The safety chase pilot may have several tasks to perform on any one mission ranging from his or her ever present duty of clearing the area, which can be done at a considerable distance from lead, to one of moving in close to check lead or observe some system in operation. Because of the many variables involved, numbers prescribing separation distances and angles are virtually impossible. A good starting point is to define safety chase position as a close approximation to a "Fighting Wing Position" (a 60° cone 500 feet to 1,500 feet behind lead). However, this must be modified by many considerations and, consequently, the safety chase position will vary with the maneuver

being flown.

a. On a well-planned mission, the chase pilot can preplan the actions that need to be taken to be in the right place at the right time throughout the flight. This requires a good briefing where each test point is discussed and all questions are resolved. After considering the test maneuvers and the performance characteristics and operating limits of the chase aircraft, the chase can then plan such things as the configuration to be used at each test point, where he will be in turns, and where he will be at the start of each maneuver (high, low, etc.). The chase should plan to configure his aircraft (gear, flaps, etc.) so that it handles well in the regime where the test is flown; the chase configuration need not match that of lead. The chase pilot may also discover that some test points cannot be reached because they are outside of the chase aircraft envelope. If so, the test card may have to be modified, or the chase pilot may use geometry to compensate for speed incompatibilities.

b. Although it is difficult to spell out all of the safety chase positions and techniques, some situations which are very often encountered are discussed below.

(1) Clearing - Clearing is best accomplished by a chase position which allows the chase pilot to look through the lead. When clearing the area is the primary concern, the chase should "move it out," spending less time flying position off lead and using more time to look around. On some missions, the safety chase pilot may answer radio calls to RAPCON and should remain alert to all traffic advisories and maintain a mental picture of the traffic situation. Traffic that is definitely not a threat to lead should not be called out. If this type of traffic is called by RAPCON, chase should quickly indicate a "tally" and state "no factor" so that lead can devote full attention to the test point. The clock position, range and relative altitude of traffic that is or may become a threat should be called so lead can maneuver to avoid conflict. If the situation warrants, chase should make a directive call to lead to avoid a conflict/collision. When a telemetry voice channel is used, the need for minimum radio chatter is particularly valid. While not heard by the chase pilot, the free use of this channel by the test pilot is essential to the conduct of the mission.

(2) Crossovers - In a good safety chase position, the chase pilot will be able to cross over freely at will and should do so as necessary without notifying lead. If external stores are carried, chase should not cross below and behind at any time. The chase should drop far enough back to crossover high with lead in view below the nose.

(3) Chase Formation - The chase may be required to move in close to the test aircraft, either as a pre-briefed part of the test or to check for leaks, loose panels, aircraft damage, etc., which have developed during the flight. Whenever chase feels that a closer look is necessary, chase should not hesitate to do so. Like the join-up after takeoff, chase should state the intention to join-up close, receive clearance, and call when clear again. Extreme

caution should be used when flying in close especially in areas not familiar to the pilot. The flow in some areas may be extremely turbulent or strong enough to cause loss of control of the chase aircraft (wingtip vortices, for instance). The possibility of being hit by external stores or parts which are released from the lead aircraft should also be considered. External stores do not always drop cleanly away and down, but are affected by the flow around the test aircraft. It should also be remembered that the flow around the chase aircraft will interact with that of the test aircraft.

(4) Accelerations/Decelerations - Chasing an aircraft with superior acceleration/deceleration capability is a situation which requires advance planning and judgment. If the chase aircraft has poor engine response characteristics, a minimal acceleration advantage may sometimes be gained by going to a high power/drag device combination just before the accel and then retracting the drag device when the accel starts. It may also be necessary to sacrifice position initially to gain a better position later. Prior to an accel, the chase should move up and forward to gain an advantage, and prior to a decel, move down and back. Depending on aircraft characteristics (handling qualities, aircraft limitations, spin characteristics), a sideslip can sometimes be used in a decel. In the worst cases to keep from overshooting, it may be necessary to pull up and away from lead, or to make high "G" S turns behind the leader. Accel/decel maneuvers should always be planned so as to keep lead in sight and chase should never get out in front of lead unless specifically briefed.

(5) Turns and High "G" Maneuvers - If the test requires that the chase aircraft hold an exact position during a high "G" maneuver (as in photo chase), it is essential that the chase aircraft have a sustained "G" capability at the test point; there is very little that the chase pilot can do to compensate for an aircraft with negative P_s. However, safety chase can satisfactorily be accomplished with a lower performance aircraft if there is no requirement to hold a precise position. Chase should maneuver its aircraft so as to remain clear, clear the area, observe the test aircraft, and be in a satisfactory position at the end of the maneuver. Normally, the chase should plan to be on the outside of the turn at the start of the maneuver, but should not be in a position which would be hazardous if lead unexpectedly turned into the chase aircraft. In a thrust limited situation, it may be advantageous to be high on lead at the start of the turn. In some situations, a turn advantage can also be gained by pulling up and reducing airspeed, G load, and turn radius while at the same time gaining altitude which can be used to rejoin after the maneuver. In all cases of accels/decels and turns, the emphasis is not on maintaining a specific position in relation to the test aircraft, but being able to visually clear the aircraft's' flight path, staying out of the way, and being in a position to observe/support the test aircraft.

(6) Rejoins - During most chase sorties expeditious rejoins may be required

between test points to perform required safety checks or to position for additional test maneuvers. It is important that chase efficiently execute any required rejoins to minimize delays on the test aircraft profile. The advanced rejoins described below will enable you to practice rejoin techniques from a variety of conditions and demonstrate the importance of proper energy management, visual look-out and three dimensional maneuvering.

a. Set-up Most advanced rejoins will be started from a line abreast position in tactical formation. You should position yourself 4,000-6,000 ft line abreast (for the T-38) or 6,000-9,000 ft (for the F-16) as depicted in Figure 5.1a. You can easily attain this set-up from close formation if each aircraft executes an aggressive 45° check turn away from the formation until reaching the desired spacing.

b. Type I From a line abreast co-speed condition of 350 KIAS the lead aircraft executes a 30° bank level turn into the chase. The chase then performs a rejoin using a high yo-yo, barrel roll, or lag turn maneuver as shown in Figure 5.1b. (Lead parameters of airspeed, load factor

SET-UP

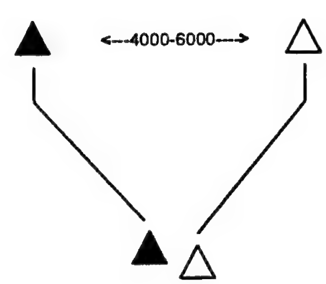

FIGURE 5.1a

TYPE I

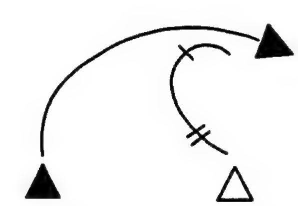

FIGURE 5.1b

FIGURE 5.1

and altitude can be varied to increase the difficulty of the rejoin. The chase can also set up with a 50-100 kt airspeed advantage.) In a lag turn the chase remains in the same plane as the lead and points behind the lead. Aspect will decease (i.e., the chase will move more to a six o'clock position) but angle off will increase (greater difference in heading between lead and chase). At some point the chase will need to maneuver to realign fuselages. Maneuvers such as high yo-yo, where the chase pulls up and out of the lead's plane, give the desired decrease in aspect without the magnitude of angle off increase associated with a lag turn. A barrel roll behind the lead while lagging the lead is another type of out-of-plane maneuver to decrease aspect and keep angle off low.

c. Type II From the tactical formation set up each aircraft should check turn 45° away and then execute a 135° turn into the formation to achieve a 180° heading crossing angle. The chase aircraft should maintain an altitude and heading to pass co-altitude and to the right of the lead aircraft with at least 1,000 ft clearance. At the merge position, the lead aircraft executes a level 3g turn at 350 KIAS as depicted in Figure 5.2a. The chase should begin maneuvering at the merge to effect an expeditious rejoin.

d. Type III Using the set-up as described previously to merge with a 180° heading crossing angle, the lead aircraft then execute a loop followed by an immediate 4g turn in either direction as shown in Figure 5.2b. The chase again begins to maneuver at the merge to effect a rejoin.

5. Landing.

The safety chase sortie does not end with the last data point. Clearing the area and not hindering the lead becomes more important during traffic pattern entry for a number of reasons. The traffic pattern is a high density area which requires every pilot in the flight to be looking for other traffic while, at the same time, traffic advisories from a radar controller are not normally available. In addition, many test sorties return with a minimum amount of fuel and need to make an expeditious entry and landing. A loose wing position is normally adequate on initial since it allows the chase to look around while, at the same time, maintaining flight integrity. The desire to "look good" is not justification for close formation. As before, if chase flies close, chase should state intentions and receive clearance prior to moving in. The chase pilot maintains his chase responsibilities until cleared off by the test aircraft. This normally occurs at the break from initial, or at touchdown after completing a chase of the final turn or straight-in. In any event, the specific point where the chase is relieved of his responsibilities must be explicitly briefed and understood. When the chase pilot makes the landing, several considerations must be anticipated. Reduced runway separation standards are presently in

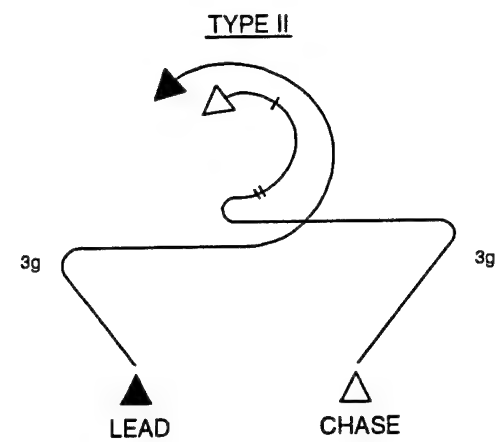

FIGURE 5.2a

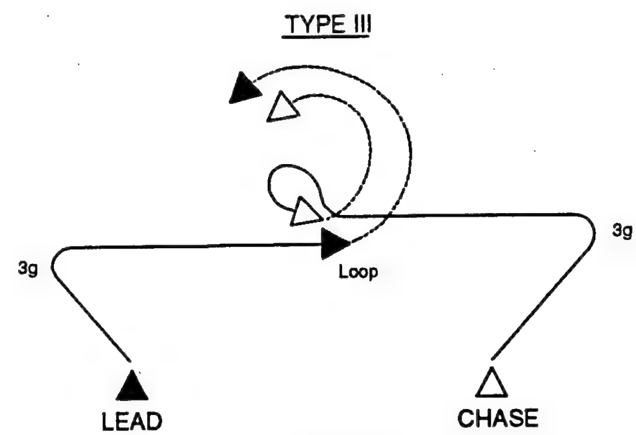

FIGURE 5.2b

FIGURE 5.2

effect at Edwards AFB. Consideration must be given to final approach airspeeds and deceleration rates of dissimilar aircraft, particularly if drag chutes are used. Wake turbulence should also be a definite consideration, particularly in the T-38.

PHOTO CHASE:

1. The essential difference between photo and safety chase is the added team work between the lead and chase pilots and the chase pilot's responsibilities to the photographer. The amount of team work required between the lead and chase pilot will depend on the maneuver being flown, aircraft differences and the photo position required. Procedures to be used and problems peculiar to a particular mission should be discussed and resolved during the briefing. Needless to say, the photographer must understand the photo requirements of the mission.

2. The chase pilot is responsible for providing the photographer with a smooth, stable platform in the required position. A good technique is for the chase pilot to have the photographer direct him to the desired position sometime prior to the actual photo run. On the actual run, chase should try to set up early enough to get additional corrections if required, but should also keep in mind that being slightly out-of-position is better than flying so rough that the photographer cannot keep the picture framed. Additionally, a camera weighing as much as 15 pounds can become uncontrollable under conditions of sudden, unannounced positive or negative gs. Photographers have been severely injured by pilots that fail to inform them when loading the aircraft up (i.e., pulling four to five Gs before the photographer has time to put his camera down). Besides the potential for injury, a camera can also become wedged against the flight controls. If timing is critical on a photo run, as in stores separation, a countdown should be requested. Lead must give some consideration to the chase aircraft's positioning problem. If unable to get in an adequate photo position, the chase must let lead know. What could be more embarrassing than dropping an unrecoverable store and not getting the required photo coverage?

3. The chase pilot should also insure that the photographer understands the aircraft egress system, and has a plan for storing or jettisoning the camera in case of bailout. Some cameras are too bulky to be adequately stored prior to ejection, thus the photographer must jettison the rear canopy and camera prior to being able to safely eject. The pilot must specifically inquire and brief this contingency when applicable. The photographer must also know how to operate any rear cockpit equipment which may be needed during the flight.

TAKEOFF/LANDING CHASE:

1. The objectives of takeoff and landing chase are either safety observation or photography (or both) of the test aircraft. The objective must be clearly defined because the criteria and priorities for each are different. The objective for safety observation is to observe the test aircraft during takeoff and landing, being able to make a safety call if necessary, and being in a position to provide support. As such, no specific position is required although a co-speed trail offset is normally optimum because it provides adequate support yet minimizes the possibilities of the chase overrunning the test aircraft.

2. Conversely, photographing a test aircraft making a takeoff or landing requires a precise and specific position. The requirements of the photograph must be clear. The position and co-speed requirements for a video tape of a takeoff roll (used for public relations purposes) are different from that of a high-speed filming of flap or gear retraction (used for engineering purposes).

3. Chase positioning for both a photographic and safety chase of a takeoff is normally

accomplished from an overhead orbit immediately after takeoff, but can also be done from a run-in from a holding fix. If an airborne pickup is to be made, the test aircraft must notify ground control when request for taxi is made. The call to tower for takeoff should also state "airborne pickup". Takeoff clearance and clearance for the airborne pickup is clearance to fly the required pattern. The chase aircraft takes off first and immediately performs a closed pattern. The pattern should be slightly larger than normal, but the precise pattern and airspeeds are determined by individual technique. Minimum airspeeds for the closed pattern and downwind are normal pattern limits. Minimums for the base turn and final run-in portion of the pattern are the base turn airspeed for the aircraft weight and configuration and no lower than 200 feet AGL. Several different techniques exist to successfully accomplish an airborne pickup. Generally, the test aircraft releases brakes on cue from the chase aircraft. This can be done by timing calls (e.g., 30 seconds), or by command (e.g., "release brakes - now"), or combination of both. The chase airspeed and position when the aircraft rolls must be planned in advance, based on the test aircraft performance so as to arrive at the required position at the proper time.

4. Landing chase generally involves being in position to observe or photograph the test aircraft at touchdown. Again, the specific requirements must be clearly understood. It is a requirement for chase to check and confirm his leader's gear is down with a radio call such as, "three down and dry." It may be necessary for the chase to drop back on final to allow for a difference between the chase minimum airspeed and the touchdown speed of the test aircraft. The chase should plan a minimum airspeed for the aircraft based on handling qualities and go-around or single-engine capability with no altitude loss. In no instance will the chase aircraft go below computed final approach airspeed for the aircraft weight and configuration. For USAFTPS missions, the chase aircraft will not descend below 200 feet AGL. At Edwards, unless mission requirements dictate otherwise, the chase aircraft should stay to the North of runway 04/22 so as to avoid a conflict with traffic at South base.

ORDNANCE DELIVERY CHASE:

1. Ordnance delivery chase involves the obvious hazards of an undesirable contact with the ground and the possibility of being struck by ordnance. As a first step toward avoiding contact with the ground, the chase pilot should check the dive recovery performance of the aircraft against the planned test points, allowing for a delayed reaction time caused by being on the wing. The possibility also exists that the chase may have obstacles in its flight path which are not in lead's flight path. If photo chase requirements dictate operating close to minimum pullout altitudes, the chase should set its own minimums and stick to them. Most ordnance delivery missions will include at least one dry pass which will allow the chase pilot to check his

flight path and the pullout conditions. It may be advisable for the chase pilot to hang back during the dry run and plan the route to avoid any problems. If the mission is safety chase, there is no requirement to get close to minimum altitudes; the lead aircraft can be checked on the downwind between passes.

2. The possibility of the chase aircraft getting tangled up with released ordnance is an ever-present hazard. Unless mission requirements dictate otherwise, the best policy is to have adequate lateral separation (100 ft minimum) be forward (near the abeam position) and be alert for unstable ordnance releases and misfires. If photo chase is required, cameras which allow the best stand-off capability should be used. Since gravity weapons will not move forward in relation to the drop aircraft but may drift spanwise and aft as they drop away, the best position for this type ordnance is line abreast. A position slightly aft of line abreast is generally best for forward firing ordnance; however, it should be remembered that such ordnance may not always go forward.

3. Ordnance delivery maneuvers typically used in a test environment are:

a. Straight Ahead Pushover. This maneuver is used for controlled deliveries when the dive angle is 30° or less. The advantages are repeatability and accuracy for hitting an exact "window" or release condition. It is used for radar-controlled deliveries extensively. The photo chase aircraft starts in the desired release position and simply maintains the "picture" throughout the maneuver. (Be aware of the camera operator's problems when you're pushing negative Gs and then pumping the stick, etc.) Power is normally reduced during the dive.

NOTE

The straight ahead pushover maneuver is not intended to be a negative G maneuver.

CAUTION

IN THE EVENT OF NEGATIVE G's, THE LIFT VECTOR IS REVERSED; THEREFORE, ROLLING AWAY FROM THE LEAD AIRCRAFT WILL CAUSE THE CHASE AIRCRAFT TO TRANSLATE TOWARDS THE LEAD AIRCRAFT.

b. Flip-Flop Deliveries. This maneuver is used for controlled deliveries when the dive angle is greater than approximately 30°. It is used extensively in a radar controlled environment where parameter repeatability is required. The photo chase aircraft starts the maneuver in the normal spread position spaced approximately 200 to 500 feet laterally, depending upon camera focal length and final spacing requirements. The lead aircraft or radar controller will give a countdown or warning call just prior to the first rolling maneuver. The

lead aircraft rolls 180° away from chase to the inverted position in approximately three to four seconds (not too fast or too slow). The photo chase aircraft also rolls toward the lead 180° trying to get inverted slightly ahead of lead. These are 1g or less rolls, not loaded rolls. Since the photo chase has just changed wings for formation reference, the pilot's head will swivel/rotate from one side of the cockpit to the other. Once inverted, fly formation on lead trying to look predominantly at the top side of his aircraft. This position will initially make lead appear slightly above the horizon. Maintain this relative position and pull down with the leader to the proper dive angle. The lead then rolls 180° away from chase (i.e. opposite the direction of the first roll) to the wings level attitude; maintain the proper dive angle. For subsonic releases, power is normally brought to idle as required during the maneuver so as to achieve the desired release airspeed at the correct altitude.

c. Roll-In Delivery. In a testing environment, this maneuver is used when visual deliveries are satisfactory and/or when a maximum number of passes is required. The setup time is normally much shorter than for radar controlled deliveries. The actual release commands on final may be given by a ground controller, or the test aircraft may control the release event. The roll-in delivery can be used for both shallow and steep dives. The roll-in used on a gunnery range or in combat is usually not satisfactory for a photo chase aircraft to follow in a test environment. The lead should start the maneuver from a level stabilized 90° base position and give a warning to the photo chase when the roll-in will begin. As leader, make sure chase is ready to go since chase data (the photos) are all important. The leader should begin the maneuver by rolling to approximately 90° plus the planned dive angle. The leader then pulls the aircraft down to the dive angle while changing the heading by 90°. The leader then rolls wings level to continue down toward the target. Maintain a constant dive angle until "release." The photo chase begins the maneuver on the same side as the final photo position. At the Test Pilot School this is normally outside the turn (opposite the direction of the roll). Roll with the leader matching lead's roll attitude precisely. Pull down and turn with the leader attempting to stay at or below lead's altitude. It will appear that you have changed wings during steep dive roll-ins but this will be resolved when the leader rolls out. Do not fly in the lead's plane of motion (so as to avoid an inadvertently released ordnance) nor stack well-above the lead's altitude (this will leave you in a high position at rollout.) Adjusting from a high position back to where you can photo lead's underside is very difficult.

d. Loft Delivery. This maneuver is to deliver lofted weapons at climb angles as high as 90°. Normally 45° of climb is as high as the loft is accomplished. The lead aircraft confirms chase is ready to pull and gives a warning call. The pull-up is accomplished at approximately 4gs to the desired pitch attitude. This attitude is held until release, adjusting power and pull-up point to achieve the desired release conditions. Chase maintains a constant photo position

throughout the maneuver. The sun position is especially important for loft deliveries. Following release the leader should roll and turn away from chase and allow the nose to fall to pick up recovery airspeed. Do not push over for recovery as you will be following the weapon's (ballistic) flight path.

4. The final phase of the ordnance delivery is the same regardless of the method used to get there. Power is adjusted as required to achieve the release airspeed/Mach. Photo chase should use drag devices/power as necessary to achieve the required position. The lead aircraft or radar controller should give a "ready, read, pickle" or equivalent radio call to initiate the weapon release and allow the camera operator sufficient warning. The photo chase must call "skip it", or an equivalent abort call, if not ready for the release. If you don't speak up, the data point is hard to repeat with one of a kind test items. During the maneuver tell your camera operator "camera up" when the flip-flop or roll-in is completed. After the release, warn the camera operator "camera down" prior to initiating dive recovery. The camera operator will vector you "up", "down", "in", "out", "forward", "aft", etc. prior to release. Use normal, smooth formation flying techniques to achieve a good stable photo platform. The photo requirements usually include several seconds of weapon travel after release. This could be as long as fuze function or even impact. Be aware that the photographer has no idea about your aircraft's attitude or altitude and may vector you beyond safe limits when following a weapons trajectory. Debrief your leader after each pass if unusual circumstances were observed, i.e., weapon pitching, tumbling, floating up, etc.

5. As a primary objective in having a photo chase during ordnance delivery lies in good photographic coverage at weapon release, plan ahead to place the wingman "up sun" at release. Photo documentation can be destroyed due to glare or shadows if sun angles aren't considered.

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T-38 FORMATION AND CHASE FAM (MULTI PILOTS)

REFERENCES:

1. Chase Procedures and Techniques, Section V, Flying Qualities Phase Planning Guide"
2. AFFTCR 55-2
3. Talon Guide

PURPOSE:

1. To provide an introduction to requirements and techniques of formation and photo/safety chase to multi-engine pilots and allied pilots as required.

2. To provide formation and chase practice.

AIRCRAFT:

Two T-38s

GENERAL:

1. This mission has been designed to provide multi-engine and allied pilots a brief refamiliarization with formation skills, and an introduction to typical photo and safety chase positions and techniques.

2. The crews will brief and operate as a formation flight. Formation takeoffs or landings will not be made. The Talon Guide will be used as a reference for formation position procedures.

3. Close formation, safety chase and photo chase will all be flown. Responsibilities as a chase are given in the introductory material in this section of the Planning Guide. Other specific duties of the wingman/chase (radio calls, IFF, etc.) will be covered in the flight briefing.

MISSION EVENTS:

1. Mission Preparation.

The pilot will review the reference material on formation and chase procedures.

2. Briefing.

An IP will give the flight briefing and brief on formation/chase procedures, requirements for each event, and techniques. Each IP will then conduct individual flight briefings.

3. Pre-Flight/Ground Operations.

Pre-flight and ground operations will be conducted as a formation flight.

4. Airborne Pickup.

Pilots will perform max power takeoffs with chase performing an airborne pickup simulating a photo of lead at liftoff.

5. Join-up.

Pilots will perform the join-up as expeditiously as possible. The chase pilot will call "coming aboard" and get clearance, prior to joining up.

6. Safety Check.

The chase pilot will then perform a safety check.

7. Formation Lead and Wing.

Chase will then join into close formation position and practice close formation during climbs/descents and turns/lazy eights. Cross-unders, advanced rejoins Type I, II and III, configuration changes, pitch-outs and rejoins (optional), and close trail (optional) will be flown.

8. Safety Chase.

Chase will then go to a safety chase position for a series of typical flight test maneuvers. Position requirements will be for clearing and observation of the test aircraft. Maneuvers to be flown will be:

a. 1G Mil Power Accel/Idle Decel - 300 KIAS - 400 KIAS - 350 KIAS at 20,000 ft MSL. (Optional)

b. Mil Power P_s=0 Turn - 350 KIAS 18,000 ft MSL.

c. Approach to stall - Lead will stabilize at 220 KIAS, TLF, PA, then increase pitch attitude to initiate a bleed rate for an approach to stall with recovery at moderate to heavy buffet.

9. Photo Chase.

Chase will then get in position for photo coverage of a series of simulated weapons releases using the roll-in technique. The objective of the lead aircraft is to get the desired release parameters and the objective of chase is to get photo coverage of the simulated weapons release. (Base parameters are 17,000 ft MSL, 300 KIAS with release at 10,000 ft MSL, 450 KIAS.) Refer to the guidance in the introduction of this section for specific techniques during simulated weapons releases. A pushover delivery may also be accomplished as fuel permits.

10. Lead Change.

At 2,200 pounds of fuel remaining, the pilots will change lead and repeat Events 7 through 9.

11. RTB.
At 1,200 pounds of fuel remaining, the formation will return to the traffic pattern.

12. Photo Chase Touch and Go.
The lead aircraft will fly an overhead pattern with a touch-and-go landing. The other pilot will chase lead and simulate photographing lead's touchdown. The photo safety chase aircraft will not descend below 200 feet, or slow below appropriate base and final pattern speeds. Photo safety chase will use flaps.

13. Lead Change.
After a touch-and-go, the lead aircraft will position the flight to change leads. This may be accomplished from an extended closed pattern or during a south re-entry. The new lead will clear his wingman to assume the photo safety chase position.

14. Photo Chase Touch and Go/Full Stop.
Repeat Event 12. The lead will full stop, or do a touch-and-go, as fuel dictates. Flight separation will be accomplished from a sequenced closed pattern if lead does a touch-and-go.

15. Debriefing.

INSTRUMENTATION/DATA REDUCTION/REQUIRED PLOTS:
None.

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F-16 FORMATION AND CHASE FAM (PILOT)

REFERENCES:

1. Chase Procedures and Techniques, Section V, Flying Qualities Phase Planning Guide
2. AFFTCR 55-2
3. Viper Guide

PURPOSE:

1. To provide an introduction to requirements and techniques of photo/safety chase.
2. To provide formation and chase practice.

AIRCRAFT:

Two F-16Bs (any configuration)

GENERAL:

1. This mission has been designed to provide a brief refamiliarization with formation skills and an introduction to typical photo and safety chase positions and techniques. As an introduction, the events and maneuvers are flown in similar aircraft and configurations. As most chase missions are flown in dissimilar aircraft, subsequent missions will emphasize dissimilar configurations and be in dissimilar aircraft.

2. The crews will brief and operate as a formation flight. Students will not perform formation takeoffs or landings; however, instructors may demonstrate either for proficiency. The Viper Guide will be used as a reference for formation position procedures.

3. Close formation, safety chase, and photo chase will all be flown. Responsibilities as a chase are given in the introductory material in this section of the Planning Guide. Other specific duties of the wingman/chase (radio calls, IFF, etc.) will be covered in the flight briefing.

4. The back-up for this mission is the T-38 Formation and Chase Fam.

MISSION EVENTS:

1. <u>Mission Preparation.</u>

The pilot will review the referenced material on formation and chase procedures.

2. <u>Briefing.</u>

An IP will give the flight briefing and brief on formation/chase procedures, requirements for

each event, and techniques. Each IP will then conduct individual flight briefings.

3. Pre-Flight/Ground Operations.
Pre-flight and ground operations will be conducted as a formation flight.

4. Airborne Pickup.
If an IP formation takeoff is not performed, chase will perform an airborne pickup simulating a photo of lead at liftoff.

5. Join-up.
Pilots will perform the join-up as expeditiously as possible. The chase pilot will call "coming aboard" and get clearance prior to rejoining.

6. Safety Check.
The chase pilot will perform a safety check and call "clean and dry".

7. Formation (Lead and Wing).
Chase will then join into close formation position and practice close formation during climbs/descents and turns/lazy eights, to include cross-under. Close trail is optional, but may be flown if pilot proficiency and fuel allows.

8. Safety Chase (Lead and Wing).
Chase will then go to safety chase position for a series of typical flight test maneuvers. Position requirements will be for clearing and observation of the test aircraft. Maneuvers to be flown will be:

a. 1g A/B Accel/Idle Decel: 20,000 ft, 250 KIAS to 0.95M (approximately 450 KIAS), then decel to 350 KIAS. Chase will be limited to MIL power.

b. Mil Power P_s=0 turn: 20,000 ft, 350 KIAS. (Optional)

c. Maneuvering Flight, Slowly Varying Method: 350 KIAS. Data Band 20,000 - 18,000 ft. Discontinue windup turn upon reaching 15 degrees AOA.

d. 1 G Limiter Decel: Lead will setup in the cruise configuration at 20,000 ft and 200 KIAS, then select Idle power and slow until establishing the aircraft on the AOA limiter. When established on the AOA limiter, lead will apply left and right rudder to check for rudder fadeout by the Flight Control System. Chase should be positioned to photo these rudder inputs and confirm no rudder movement.

9. Advanced Rejoins.
Setup as described in the introductory section of the Phase Planning Guide and perform Type I, II and III advanced rejoins.

10. Photo Chase (Lead and Wing).

Chase will then get in position for photo coverage of a series of simulated weapons releases. the objective of the lead aircraft is to get the desired release parameters and the objectives of chase is to get photo coverage of the simulated weapons release. Refer to the guidance in the Introduction of this Section for specific techniques during simulated weapons releases. The maneuvers should be flown in the following order. To insure the chase has a valid platform for the weapons deliveries, IPs may fly/demo these maneuvers as lead if the student is not previously experienced in air-to-ground.

a. Pushover Weapons Delivery: Setup at 17,000 ft MSL, 300 KIAS. Release parameters - 30° dive, 450 KIAS, 10,000 MSL.

b. Roll-In Delivery (Optional): Setup at 17,000 ft MSL, 300 KIAS. Release parameters - 30° dive, 450 KIAS, 10,000 MSL.

c. Flip-Flop (Optional): Setup at 17,000 ft MSL, 300 KIAS. Release parameters - 45° dive, 450 KIAS, 10,000 MSL.

d. Loft Delivery (Optional): Setup following the pushover at 8,000 ft MSL, 450 KIAS, and MIL power. Initiate 4g pull. Release parameters - 45° pitch at 4g.

e. Roll-In Delivery (Optional): Setup at 17,000 ft MSL, 300 KIAS. Release parameters - 45° dive, 450 KIAS, 10,000 MSL.

11. Lead Change.

The lead will then be switched and Items 7 through 10 will be repeated. Optional items will be accomplished at the discretion of the instructor pilot. Proficiency is not required.

12. RTB and Photo Chase Landings.

The flight will then return to the pattern and each pilot will chase a straight-in approach and landing, and a landing from the overhead pattern. Chase requirements will be photo coverage of the touchdown in each event. Minimum altitude and airspeeds are 200 ft AGL and base/final approach airspeeds for the aircraft configuration and airspeed. At least one landing must be chased for mission completion. Lead will be exchanged on outside downwind.

13. Debriefing.

IP's will critique the flight on performance of formation/chase procedures.

INSTRUMENTATION/DATA REDUCTION/REQUIRED PLOTS:

None.

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PHOTO/SAFETY CHASE FLIGHT (PILOT)

REFERENCES:

1. F-16 Flight Manual
2. T-38 Flight Manual
3. Chase Procedures and Techniques, Section V, Flying Qualities Phase Planning Guide
4. AFFTCR 55-2

PURPOSE:

1. To practice techniques and procedures for proper photo and safety chase mission support using dissimilar aircraft.

2. To demonstrate ability to plan and accomplish a typical test mission in a safe and efficient manner.

AIRCRAFT:

1. F-16 Lead (centerline fuel tank desired, 2 wing tanks okay)

2. T-38 Photo/Safety Chase

GENERAL:

1. An important part of the test pilot's flying involves safety and photo chase support. A large percentage of test missions require some sort of chase support, depending on the requirements of a particular test program. Several missions in the USAFTPS curriculum are devoted to training in this area.

2. This mission should prepare you to meet chase requirements anticipated in your future duties. The mission includes a broad cross section of flight test maneuvers. The use of dissimilar aircraft adds additional realism. This mission should prove to be one of your most challenging and interesting flights in the curriculum.

3. Each pilot will fly the mission twice, once as lead (simulated test aircraft) and once as the chase (simulated photo/safety chase). Student pilots will be paired as a test team and fly both rides together, schedule permitting. As lead, the emphasis will be on mission planning, execution and precise accomplishment of each test maneuver. The emphasis as chase will be on planning, teamwork and proper and safe positioning. Review the Chase Procedures and Techniques discussion in this Planning Guide for detailed guidance.

4. Both pilots will plan the complete mission profile to include mission sequence, maneuver

setup, transitions between maneuvers, area orientation and fuel management. The test aircraft will attempt to adhere to the data tolerances previously taught.

5. In practice, the safety chase position is not fixed, but is determined by mission parameters such as test aircraft, mission profile and type of tests. For this mission, two specific safety chase positions will be defined: one a "close" safety chase position, and the other an "extended" safety chase position. The "close" position will be four to five ship widths wide (100-150 feet) and five to six ship lengths back (250-300 feet). The "extended" position will be a lookout/maneuvering position similar to the old "Fighting Wing Position". The "extended" envelope is 500 to 1500 feet behind the lead aircraft and in a cone 60° either side of the lead. Keeping these two "defined" positions in mind, all the normal chase procedures, techniques and considerations still apply.

6. Photo chase positioning depends upon the particular test maneuver. Proper photo position will be briefed for each event. The T-38 IP will act as the airborne photographer and may direct minor position adjustments in flight. Verify correct positioning with the IP and accomplish necessary in-flight coordination with the lead aircraft to obtain good photo coverage.

7. Due to the nature of this sortie, there is a high potential for the chase aircraft to overrun the test aircraft in some instances; especially if the setup for a particular maneuver is compromised. If the chase aircraft does overrun the test aircraft, the chase aircraft will call "passing on the left (or right)," the test aircraft will discontinue its test point, and the flight will be safely rejoined.

LIMITATIONS:

1. Students will review Flight Manual limitations, high speed flight characteristics and recognition and corrective action for compressor stalls, engine rollbacks and flight control malfunctions.

2. The following specific limitation will be observed:

a. The mission will be flown only as a two-ship flight.

b. Aircraft will not carry external stores except for centerline fuel tank (desired) or 2 wing tanks on F-16.

c. Aircraft will be aborted whenever there is a known or suspected flight control malfunction.

d. Area Bingo fuels will be planned to allow for accomplishment of two chase traffic patterns.

MISSION EVENTS:

1. Mission Planning.

a. Pre-flight mission planning will be a joint effort between the two students. Students will concentrate on techniques to insure they are in the proper position throughout the data band for each event. The proper radio calls must be carefully planned so each student is adequately prepared to effectively execute their duties during each event. A discrete UHF frequency should be requested. For events that result in a difference in airspeed between the chase and data aircraft, it is particularly essential to develop a distance and closure rate that will result in the photo chase arriving at the appropriate position as the event occurs. Energy management is a vital consideration; it is possible to terminate the mission early through poor planning and excessive fuel usage. Some examples of other specific considerations that should be preplanned are: IFF squawk; sun angle; instrumentation (narrow tracking beacon); and "lost communication" hand signals. If you make this a well planned and tightly coordinated venture, you can expect a smooth and productive flight!

b. In-flight mission planning is primarily the responsibility of the F-16 test pilot who will retain lead of the flight throughout the mission. The F-16 pilot should realize the fact he is in the test aircraft and is responsible for the overall flow and accomplishment of the test points. Coordination is still encouraged between lead and the chase aircraft.

2. Briefing.

The student in the F-16 aircraft will present the general flight briefing. The lead pilot will brief the simulated test events and will assign chase duties and responsibilities to insure adequate chase support. Carriage of an external store at some pre-briefed station on the F-16 will be simulated for the entire mission. The T-38 pilot will brief specific items pertaining to the chase aircraft, i.e., limitations, photography considerations, etc.

3. Takeoff/Airborne Pickup/Safety Check.

Coordinated engine start procedures should be followed to minimize the fuel consumption of the T-38 during ground operations. Prior to taxi lead should advise ground control, and prior to takeoff advise tower an airborne pickup will be made. After No 1 (the F-16) and No 2 (the T-38) complete their run-up checks, No 2 will takeoff and immediately perform a closed pattern. Chase's base to final turn will be computed so chase can setup a closure rate with No 1 that will allow chase to arrive at a photo chase position at the precise time No 1 lifts off the ground. Chase minimums are base turn airspeed for configuration and fuel loads and 200 feet AGL. Chase will make appropriate radio calls. No 1 will make a data performance MIL takeoff recording T.O. data. When cleared, chase will join into close formation and perform a safety check. This check will be performed as if the lead aircraft had external stores.

4. A/B Lite/Climb to 15,000 feet MSL.

a. The objective of this event is to document the nozzle movements with A/B initiation/functioning on the F-16. No 2 will move into an acceptable photo chase position as directed by the photographer (IP) in the rear cockpit. For safety considerations, No 2 will maintain wingtip clearance and descend low enough to insure that the canopy bow will not obscure the photographer's view of No 1's afterburner. With lead at a level flight condition at 350 KIAS, 6,000-8,000 feet MSL, the chase will begin photography 5 seconds prior to an A/B lightoff. No 1 should go to MIL power and smoothly on into Max A/B. The speed brake may be used. To maintain climb airspeed between 350-400 KIAS, No 1 may have to smoothly rotate to a steeper climb attitude after A/B is initiated. After A/B initiation there is no requirement to stay in the 6,000-8,000 feet altitude block. A minimum of 10 seconds of A/B filming will be simulated before No 2 completes filming.

b. At No 2s call, No 1 will smoothly go from Max A/B to IDLE power, smoothly pushing the nose over to maintain 350-400 KIAS. No 2 will continue to film the nozzle during A/B cancellation and until the nozzle stabilizes. No 2 will then assume the "extended" safety chase position until level off.

5. Configuration Change, 15,000 feet MSL.

a. The objective of this maneuver is to obtain a fully documented visual history of the movement of the trailing edge (TE) flaps and the landing gear. In the F-16, both the gear and flaps are extended/retracted when the gear handle is lowered/raised. The only restriction on the photo chase is lateral separation be maintained at all times. With this restriction in mind, plan to be in position with enough lead time to be stable several seconds before the actual lowering and raising of the gear and flaps. This requires close coordination between the test aircraft and the photo chase, and both crews should firmly establish the exact procedures and radio calls necessary to efficiently complete this task. As before, it is important to have a clear view of the device to be photographed, and that a countdown be given to adequately warn the photographer to turn the camera on five seconds before the event starts.

b. Landing Gear and TE Flap Extension. After level off at 15,000 ft MSL, No 1 will get a trim shot at 230 KIAS while No 2 moves into an optimum position to see all three gear, and the near trailing edge flaps. On his own call, No 1 will lower the gear handle while maintaining trim power for 230 KIAS.

c. Gear and Flap Retraction. No 1 will initiate a full MIL power missed approach after stabilizing momentarily at approach speed (11 AOA). No 2 will photo the gear and flap retraction. No 2 will have to establish some separation and then a slight closure rate to be in a good position for this photo since the T-38 will not be able to slow to the F-16's final approach

speed.

6. Level Accel/Decel.

a. The objective of this event is to photograph an external store on the F-16. No 1 will set up for a performance type level accel at 15,000 feet MSL. At 230 KIAS, No 1 will "slam accel" the throttle to MIL power and accelerate level to 400 KIAS. At 400 KIAS, No 1 will "slam decel" the throttle to idle and decelerate to 350 KIAS before terminating the maneuver. No 2 will fly line abreast and slightly low. No 2 will maintain this position and will be expected to simulate photographing the entire accel/decel from 5 seconds before start of accel/decel until termination.

b. Because of power and drag differences, lead and chase must carefully plan the event and insure there is no misunderstanding of either the sequence of events or the radio procedures. No 2 must anticipate the deceleration and may crack his speed brakes early which will prevent being out of position at the start of deceleration. As a last resort, No 2 may yaw away from lead to increase drag. The nozzle position is a good indicator of F-16 power settings. The T-38 can maintain position throughout the maneuver with proper anticipation.

7. Climb to 32,000 feet MSL/Corridor Entry.

No 1 will climb at 350 KIAS/0.9M, using approximately 850° FTIT. No 2 will maneuver to an "extended" safety chase position for clearing, and to prepare for the supersonic run.

8. Accelerate to 1.3 Mach/4g Decel.

From a level flight condition of 0.9M, 32,000 feet MSL, No 1 will perform a MAX power FQ level accel to 1.3 Mach. At 1.3 Mach, No 1 will perform a MIL power 4g level decel turn to 0.9 Mach to investigate any transonic effects. Throughout this maneuver, No 2 will fly an "extended" safety chase position as much as possible and clear for the lead aircraft. Establish overtake initially during the accel, then anticipate falling back during the run. The T-38 cannot accelerate supersonic with the F-16. Effect a rejoin during the 4g decel turn.

CAUTION

DUE TO COMPRESSOR STALL/FLAMEOUT SUSCEPTIBILITY AT HIGH ALTITUDE, OBSERVE THROTTLE MOVEMENT AND AFTERBURNER INITIATION RESTRICTIONS IN THE SHADED AND BLACK-STRIPED REGIONS OF THE T-38 ENGINE OPERATING ENVELOPE.

CAUTION

DO NOT EXCEED T-38 ROLLING G LIMITATIONS DURING THIS MANEUVER.

NOTE

Lead should request sufficient altitude in the high altitude supersonic corridor (weather permitting) for both aircraft (i.e., block FL300 - FL 360).

9. <u>0.8 Mach Descent</u>.

a. The objective of this event is to provide safety chase of a steep, high Mach dive. Using a data band from 28,000 to 18,000 feet MSL, No 1 will perform an IDLE power, speed brake out, constant 0.8 Mach pushover descent.

CAUTION

PRIOR TO INITIATING DESCENT, ADVISE ATC OF PLANNED STEEP DESCENT TO 12,000 FEET MSL AND REQUEST INFORMATION REGARDING POTENTIAL TRAFFIC HAZARDS.

b. No 2 will fly in an extended safety chase position during the entire descent from data band entry to data band exit. As in the level decel from Event 6, No 2 must anticipate the pushover and may need to use s-turns in addition to speed brakes.

10. <u>Loft Delivery</u>.

The objective of this event is to photograph a store separation. At 12,000 feet MSL, 450 KIAS, No 1 will start a simulated weapon loft delivery by going to MIL power and pulling 4gs. No 1 will call the simulated weapons release at 30° nose high. No 2 will be in a position to photograph the store separating from the lead aircraft and follow its trajectory momentarily. Be aware of the sun position for this event. Do not pushover into the ballistic path of the weapon on recovery. To repeat this maneuver, a "skip it" call must be made prior to release.

CAUTION

DURING THE LOFT RECOVERY, LEAD SHOULD ROLL AWAY FROM THE CHASE. DO NOT PERFORM A STRAIGHT-AHEAD PUSHOVER, OR ROLL INTO CHASE.

11. <u>1g Limiter Decel, 22,000 feet MSL</u>.

a. The objective of this event is to verify pilot rudder pedal inputs in the F-16 do not induce rudder deflections. While maintaining level flight, No 1 will slowly decelerate to the AOA limiter (25.5 AOA). Approaching the limiter, power may be added to minimize any descent. After applying left and right rudder pedal, No 1 will initiate recovery and accelerate in MIL power.

NOTE: Rudder should not actually move.

b. No 2 will photograph the rudder/stabilator area for 5 seconds before and after pilot input. Throughout the event, No 2 will maintain at least four ship widths (150 feet) lateral separation. No 2 may alter his configuration as required to maintain position, but should not go below final approach airspeed for that weight and configuration. A slight closure rate will be required.

CAUTION

BE AWARE OF T-38 ENGINE ROLL BACKS. T-38 THROTTLE SETTINGS WILL BE A MINIMUM OF 80% SINCE ENGINE ROLL BACKS WILL MOST LIKELY OCCUR BELOW THIS THROTTLE SETTING.

12. Maneuvering Flight (350 KIAS, 15,000-11,000 ft MSL).

The objective of this event is to perform a constant speed 350 KIAS windup turn with photo record. No 1 will stabilize at a level flight-trimmed condition at or below 15,000 MSL. Lead will then accomplish a constant airspeed maneuvering flight from 1 to 4gs. No 2 will photo chase No 1 on the outside of the turn. Frame the entire aircraft and monitor lead's altitude.

CAUTION

DO NOT EXCEED T-38 ROLLING G LIMITATIONS DURING THIS MANEUVER. ADDITIONALLY, CLOSE COORDINATION BETWEEN LEAD AND CHASE MUST BE USED AT THE COMPLETION OF THE MANEUVER TO MAINTAIN SEPARATION OF AIRCRAFT DURING ROLL-OUT.

13. Pushover Delivery.

The objective of this event is to photograph a store separation in a 30° dive. To simulate a controlled delivery starting from a level flight condition at 300 KIAS, 17,000 feet MSL, No 1 will push over to a 30° dive angle. At 10,000 MSL (7,000 feet AGL min)/450 KIAS, No 1 will simulate weapon release and start his pullout. At the simulated weapon release point, No 2 will be in a position to photograph the store separating from the lead aircraft. No 2 should anticipate the pushover and stack low on entry. To repeat this maneuver, a "skip it" call must be made prior to release.

14. Roll-In Delivery.

The objective of this event is to photograph a simulated store separation. For a roll-in weapons delivery, No 1 will establish a base leg at 300 KIAS, 17,000 feet MSL. From this base leg, No 1 will perform a left or right 90° roll-in to the target, aiming for a 45° dive angle with a simulated release at 10,000 feet MSL (7,000 feet AGL min)/450 KIAS. While on base leg, No 2 will establish a position from which he can maneuver on the outside of the turn to a photo position as lead rolls out. Avoid rolling out high on lead in the dive and having to bunt over or

losing sight of lead. No 2 will be in a position to photograph the release. A "skip it" call must be made prior to release to repeat this event. No 2 should make a visual safety check of the test aircraft after this final stores release event and report the status to No 1.

15. SFO.
The F-16 will fly a normal overhead SFO to a touch-and-go and No 2 will fly in a "close" safety chase position in order to verify No 1's landing configuration. Chase will plan to be in position for photo coverage of lead's touchdown. Chase may use flaps, gear and/or speed brake.

CAUTION

T-38 CHASE SHOULD NOT SLOW BELOW COMPUTED FINAL TURN/APPROACH SPEED FOR CHASE CONFIGURATION.

16. Straight-In/Touch-and-Go.

a. After the touch-and-go, No 1 will request a south re-entry for a straight in. The objective of this event is to photo record the F-16 landing. No 1 will set up at 3,300 feet MSL, 230 KIAS, clean configuration, for a straight-in approach. No 1 should announce to chase the computed final approach speed, if not pre-briefed. No 1 will then establish the power approach configuration (gear and flaps down, speedbrake out) between the TACAN and the east lake shore. No 1 will slow to 11° AOA by 3 NM from the runway.

b. Chase will initially be in a position to photo No 1's gear and flap extension and make a "three down and dry" call. Chase will then assume a safety chase position, planning to be nearly line abreast of the lead aircraft at touchdown for the photo. Chase minimums are 200 feet AGL and 15 kts above No 1's final approach airspeed. Chase should use flaps. Lead may make this a full stop or a touch-and-go.

c. After completing the straight-in, lead will coordinate for flight break-up. If approved for a sequenced closed pattern, the T-38 will go first, and the F-16 second. This is to ensure that the chase T-38 does not encounter the wake turbulence of the F-16.

CAUTION

ADEQUATELY BRIEF AND COORDINATE FLIGHT BREAK UP AND INDIVIDUAL RECOVERY FOLLOWING THE SECOND TOUCH-AND-GO.

17. Debrief.

Pilots: Comment on quality of test maneuvers and safety/photo positioning.

IPs: Debrief pilots emphasizing test and chase procedures/coordination and efficiency of use of time and fuel.

INSTRUMENTATION:

None.

DATA REDUCTION/REQUIRED PLOTS:

None.

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SPIN CHASE (PILOT)

REFERENCES:

1. Chase Procedures and Techniques, Section V, "Introduction to FQ Planning Guide"
2. Spin Demo/Data Mission
3. USAF TPS Regulation 60-21
4. AFFTC Regulation 55-2
5. Talon Guide

PURPOSE:

1. To act as a safety chase for T-2 spin missions.

2. To practice safety and photo chase techniques and procedures.

AIRCRAFT:

T-38

LIMITATIONS:

As listed in the Flight Manual

GENERAL:

1. The first spin chase mission on each pilot will be flown with a USAF TPS IP.

2. The aircrews involved in the spin mission will brief together as a flight. The problems of flying dissimilar aircraft in formation will be discussed.

3. The chase aircraft will function primarily as a safety chase.

4. An airborne pickup will be performed.

MISSION EVENTS:

1. Mission Preparation.

Review spin chase discussion and formation procedures.

2. Briefing.

T-2 IP and student will brief test events and flight conduct. T-38 IP will brief chase techniques.

3. Start/Taxi.

Pre-flight and ground operations will be conducted as a formation.

4. Takeoff/Airborne Pickup.

An airborne pickup may be accomplished. Radio frequency changes will not be made until past the departure end of the runway. The initial safety check is important as it establishes a baseline for the subsequent checks. If the pickup is not accomplished, chase will coordinate on join-up procedures with the test aircraft.

5. Phase A/B Chase.

6. Phase C Chase.

7. Spin Chase.

Prior to each spin, the chase pilot should be aware of the type of spin to be performed, the spin direction and position accordingly. The chase should circle the spinning aircraft during the spin and descent so as to be at approximately the spin aircraft's altitude. The chase should make a radio call if, and when, the spin aircraft passes 18,000 feet MSL and recovery has not been initiated. An additional radio call will be made at 10,000 feet MSL (7,000 feet AGL, minimum safe ejection altitude). The timing and terminology for each of these calls should be discussed and agreed upon during the briefing.

8. Rejoins out of Spins.

The chase aircraft will join up and check the spin aircraft after each spin. The spin aircraft should be inspected for any out-of-the-ordinary condition with particular emphasis on the condition and alignment of rudder, elevator and aileron controls, loose panels, inlet screens, and excessive fluids. The chase should inform the lead when moving in for the checks and receive clearance prior to joining up close. After the inspection is complete, the chase should move out, fly chase, and get in position for subsequent spins.

9. RTB Rejoin.

After the last spin, the chase will perform a final inspection of the spin aircraft.

10. SFO Chase.

Photo Safety chase the T-2's SFO and full stop landing.

11. Spot Landing.

12. Debriefing.

DISCUSSION:

1. The spin chase mission is one of the most demanding T-38 flights in the USAF TPS curriculum. It combines the requirement for high energy maneuvering with the obvious requirement for the finest energy & fuel management which is typical of any dissimilar chase.

2. The highest quality of energy management and planning are necessary to complete this mission with an adequate fuel reserve. In general, there are three areas which are important to fly this mission with an adequate fuel reserve. In general, there are three areas which are important to fly this mission well:

   a. Maintaining visual contact.

   b. Anticipating the spin airplanes flight progress.

   c. Operating the chase airplane efficiently to maximize its energy advantage.

3. The small size of the T-2 and its inconspicuous paint scheme make it difficult to keep the aircraft in sight. The need for keeping the test airplane in sight at all times is especially important because of the difficulty in reacquiring the T-2. Constant visual contact during the actual spin and rejoin is absolutely essential for safety of flight.

4. Energy management and anticipating of the spin aircraft flight progress must be discussed together since they are interdependent. The task is simply to join with the spin aircraft, as quickly as possible after each spin, for a safety check, and to chase each spin in near proximity for safety chase and altitude verification. Knowing the intended ground track and altitude profile for each maneuver will provide the background for optimizing the chase profile. Generally, it is counterproductive to fly formation with the spin aircraft except during visual inspection. At all other times, the T-38 should operate at power settings and airspeeds which are move favorable to itself in achieving the desired setup conditions.

5. The chase aircraft should always be operated within the operational envelope of the aircraft observing all Flight Manual restrictions. For instances, the throttles should not be retarded to below 80% RPM above 20,000 ft and below 200 KIAS, due to the possibility of engine rollback flameout.

6. Prior to the run-in, the chase aircraft should review the spin aircraft entry conditions and the planned spin and recovery. This will allow the chase to plan maneuvers to be in the best position at spin entry and to know when to expect recovery to be initiated. Chase ground track should consider the spin aircraft, ground track, and spin entry conditions. The T-38s should never be operated inside the turn of the spinner during pre-spin maneuvering. Large lateral offsets and a large turn radius allows the T-38 to fly faster than T-2, maximizing the

performance of both aircraft most of the time. The chase aircraft should plan a airspeeds and ground tracks based upon the spin aircraft's run-in and entry airspeeds. Lateral offsets and the use of flaps may aid in attaining the necessary separation without sacrificing airspeed.

7. It is not necessary to stay close to the T-2 during the spin. On spin entry, the T-38 should be in a position to observe the T-2 departure motions, as both a safety aircraft and for later debrief. As the spin aircraft zooms to enter the spin, the chase aircraft should zoom only as necessary to maintain chase position. Attempting to peak at the same attitude as the T-2 is usually impractical. As the spin is entered, the chase aircraft should start a descending spiral around the spin aircraft usually traveling about 180°-270° around the outside of the spin circle by the time the aircraft stops spinning. During the spin, the chase aircraft should monitor spin aircraft motion, altitude, aircraft integrity, and possible engine flameouts noted by smoke or fuel vapor. Calls to the spin aircraft will be as briefed.

8. After recovery, the spin aircraft will normally turn in the shortest direction to return to the run-in point. The objective of chase is to join up quickly and complete a safety check without any undue delay. Leaving the power set at a cruise setting during the spin chase should provide the T-38 with enough airspeed (≈350 KIAS) to "corner" the aircraft and expedite the rejoin. The use of vertical maneuvering is extremely important when attempting to position for the rejoin. Classic "fighter type" maneuver is effective provided the pilot adjusts the technique for a much slower moving T-2.

9. The T-2 spin aircraft will normally be returning to the run-in point at 230 KIAS and climbing at approximately 2000 fpm. When cleared to rejoin for the safety check, the chase should normally join on the right side (or as briefed). The chase pilot should call "clean and dry". When the safety check is completed clearing the spin aircraft to turn back toward the spin area, the chase should then take spacing and begin positioning for the next spin. **The chase pilot must be assertive during the profile and relay any information to the spin aircraft that is applicable.**

10. Following the last spin, the spin aircraft will position itself for entry into the SFO pattern on the main runway. The T-2 will maintain 230 KIAS until the safety check is completed or gliding to the field becomes impractical at 230 KIAS. The chase aircraft should join-up early enough to complete a safety check and reposition itself for chasing the SFO pattern. The expected flight path from the spin area to high key should be briefed so the chase pilot can plan the rejoin. The T-2 will normally slow to 145 KIAS after the safety check. The T-38 will normally reposition the flaps to 60% and perform large "S" turns behind the T-2. The T-38 must be cautious not to overspeed the flaps (max 240 KIAS with flaps 60%) or approach stall speed

(final turn speed minimum). The T-38 is still a safety chase during the SFO, but should position itself in a photo position for the T-2's touchdown.

SAFETY CHASE PROCEDURES:

1. If an airborne pickup is accomplished, radio frequency changes will not be made until past the departure end of the runway. The initial safety check is important as it establishes a baseline for the subsequent checks.

2. Prior to each spin, the chase pilot should be aware of the type of spin to be performed, the spin direction, and position accordingly.

3. The chase should circle the spinning aircraft during the spin and descent so as to be at approximately the spin aircraft's altitude. The chase should make radio calls if, and when, the spin aircraft passes 18,000 feet if recovery has not been initiated. An additional radio call will be made at 10,000 feet MSL (7,000 ft AGL, minimum safe ejection altitude). The timing and terminology for each of these calls should be discussed and agreed upon during the briefing.

4. The chase aircraft will join up and check the spin aircraft after each spin. The spin aircraft should be inspected for any out-of-the-ordinary condition with particular emphasis on the condition and alignment of rudder, elevator and aileron controls, loose panels, and excessive fluids. The chase should inform the lead when closing to perform the checks and receive clearance prior to joining to close formation. After the inspection is complete, the chase should move in position for subsequent spins.

5. After the last spin, the chase will perform a final inspection of the spin aircraft and photo chase the T-2's SFO and full stop landing.

6. If the aux flap switch has been used, ensure it is set back to normal for subsequent patterns.

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SUPERSONIC CHASE DEMO (PILOT)

REFERENCES:

1. F-15 Flight Manual
2. F-16 Flight Manual
3. AFFTCR 55-2
4. Chase Procedures and Techniques, Section V, Flying Qualities Phase Planning Guide.
5. Supersonic Aerodynamics, Chapter 6, Aircraft Performance

PURPOSE:

1. Demonstrate the effects of, and develop an appreciation for, the potential hazards of shock waves during supersonic formation.

2. Develop proficiency in Supersonic Safety Chase techniques.

3. Review formation techniques and practice formation flying.

4. Develop proficiency in photo chase techniques.

AIRCRAFT:

Two required - any combination of F-15s and/or F-16s with clean or centerline tank loadings.

GENERAL:

1. Both student pilots will be prepared to lead the mission and will plan the complete mission profile to include turn points, headings, times and fuel. The general mission profile to plan for will be a takeoff and climb/cruise for entry into the supersonic corridor just east of Bicycle Lake, a single corridor run terminating approximately abeam California City, several simulated weapons deliveries and two formation landing approaches.

2. Student will review Flight Manual limitations including engine envelope AB restrictions, supersonic electronic engine control malfunctions, cabin pressure malfunctions, high speed flight characteristics and recognition and corrective action for engine stall/stagnation and flight control malfunctions.

3. Review Chase Procedures and Techniques in this planning guide for detailed guidance.

LIMITATIONS:

The following specific limitations will be observed:

a. The mission will be flown only as a two-ship flight.

b. Aircraft will be flown with a centerline tank or clean; no other configuration is acceptable.

c. Joker fuel will be 4,500 pounds (F-15) or 2,300 pounds (F-16) during the supersonic portion of the flight.

MISSION EVENTS:

1. <u>Mission Preparation.</u>

The student must carefully plan this mission due to the rapid expenditure of fuel. The minimum essential planning elements for this mission are: geographic positioning, track, time and fuel. The following profile is presented as a guide:

a. Climb northeast to FL 350.

b. Request and receive clearance into Daggett Shelf.

c. Turn to a northerly heading once clear of the Goldstone Complex. Go far enough north so that you can make a right turn and climb to approximately FL 400 in MIL power turning into the corridor just east of Bicycle Lake/Fort Irwin.

d. All supersonic events will be accomplished during the single east-west corridor run, terminating no further west than abeam Mojave.

e. Terminate supersonic run by Joker fuel.

2. <u>Briefing</u>.

The lead IP will brief the mission using profile information provided by the students. The lead IP will extensively brief chase duties, subsonic and supersonic formation signals, techniques, positioning and photo chase positioning for approach and landing.

3. <u>Mil or Max Power Takeoff</u>.

Lead will perform a MIL (clean) or MAX (centerline tank) power takeoff with chase performing an airborne pickup simulating a photo of lead's liftoff.

4. <u>Join-up</u>.

Chase will join up as expeditiously as possible in safety chase position. From this position, the chase pilot must be able to keep the lead aircraft clear of other aircraft, assist in navigation and monitor the general condition of lead. While doing this, chase must be able to easily monitor its own aircraft and be sure that positioning in no way restricts the flexibility of the lead aircraft to freely maneuver. Though there are no hard and fast rules for positioning, for this mission fly

a position four-to-five ship widths wide (250-300 feet) and three-to-four ship lengths back (150-200 feet).

5. Safety Check.

On command, chase will close into close formation and perform a safety check. To be completely thorough, the safety check must include an examination of both top side, as well as the bottom side of the lead aircraft for missing panels, missing stores, fuel leaks, hydraulic leaks or flight control problems. This is best accomplished by starting slightly high on one side, dropping low, crossing under and ending up slightly high on the opposite side of the aircraft.

6. MIL Power Climb.

Close formation, consisting of mild turns and altitude changes, will be flown during the climb until 15,000 - 20,000 feet MSL. Chase the remainder of the climb and cruise to Supersonic corridor entry.

7. Enter Supersonic Corridor/Accelerate to 1.2 Mach, FL 300 - 400.

Once past the Goldstone Complex, turn to a northerly heading until a turn back to a point just east of the Bicycle Lake/Fort Irwin area can easily be accomplished. Lead should plan to be near FL 400 and on track just east of the Bicycle Lake/Fort Irwin area. Lead will call for both aircraft to go MAX power.

CAUTION

IN ORDER TO MAINTAIN REGION 1 OPERATION, MINIMUM AFTERBURNER INITIATION AIRSPEED WILL BE 250 KCAS.

It is extremely important that chase be in position at the start and during the acceleration in order to prevent a long and fuel consuming tail chase. If necessary, chase should call lead for a power reduction. The aircraft may be allowed to descend during the acceleration. At 1.15 Mach, lead will start reducing power to stabilize at 1.2 Mach.

8. Chase Investigation of Shock Waves.

a. Chase Checks Lead-(Level). As lead reduces power to maintain 1.2 Mach chase will call, "passing on right/left." It is important that chase maintain a slow passing rate while maintaining 1 ship-width separation so chase can fully investigate the effect of lead's shock waves. The most noticeable shock will be the one produced by the F-15's intakes or the F-16's nose. When chase's nose passes through the shock, the shock will tend to push chase's nose away from lead. Use rudder and/or bank angle to maintain position. As the shock reaches the tail, chase may tend to yaw into lead. As soon as chase has passed through this shock wave,

chase will decelerate back through the shocks until again in safety chase position. During the deceleration, chase will be especially careful not to angle into lead and will maintain lateral separation at all times.

b. Chase Checks Lead-(Underneath). Chase will descend until 100 feet below lead while maintaining at least 1 ship-length separation. Once established on altitude, chase will call, "passing below" and start a slow and controlled closure with lead while maintaining altitude separation. As chase approaches lead, chase will experience a pitch-down moment. After experiencing the pitch-down moment, chase will decelerate back to the starting point and then cross under to safety chase position. (In order to avoid the pitching up moment, do not continue forward acceleration past the pitching down moment.)

9. Lead Investigates Shock Wave Effect.

Command of the flight will be passed to No 2 aircraft. The No 1 aircraft will then get into the safety chase position. After stabilizing, chase will begin the shock wave investigation and complete Events 8a and 8b. The supersonic portion of the mission will be terminated at no less than Joker fuel.

10. 4G Decelerating Turn.

Chase will maintain safety chase position as long as possible during lead's turn. If chase is unable to maintain position, it may drift slowly to the outside or start a slight climb. Once lead rolls out of its turn, chase must expeditiously return to the safety chase position.

11. Photo Chase Practice.

Lead will descend and setup for a series of simulated weapons releases. Base parameters are 17,000 feet MSL, 300 KCAS. Refer to the discussion on Ordnance Delivery Chase at the beginning of this section for a description of the standard procedures/techniques. The following maneuvers will be practiced in the listed order as proficiency dictates. Change leads halfway through the fuel remaining prior to bingo. (NOTE: Minimum release altitude is 7,000 feet AGL.)

a. 30° roll-in delivery, release at 10,000 feet MSL/450 KCAS.

b. 45° flip-flop delivery, release at 10,000 feet MSL/450 KCAS (Optional).

c. 45° roll-in delivery, release at 10,000 feet MSL/450 KCAS (Optional).

d. 45° loft delivery, release at 4g's. Four g pull from setup at 8,000 feet MSL, 450 KCAS, Mil power (Optional).

12. Descent.

The flight should then descend so as to position itself for a straight-in approach at Edwards AFB. The No 2 aircraft will resume safety chase position.

13. Photo Chase Landing.

The lead aircraft will attain the full flap power approach configuration with radio calls or signals, and slow to on-speed AOA by mid-lakebed/900 feet AGL. Chase will maintain the safety chase position but will simulate an aircraft with a higher approach speed. Chase minimums are 200 feet AGL and 15 knots greater than on-speed AOA with gear and flaps down. At touchdown, the chase should be nearly line abreast of the lead aircraft, so that if a photographer were on board he would be able to fully cover lead's landing. This necessitates chase flying a safety chase position such that sometime during the final approach it must establish a closure rate that will put it nearly line abreast at touchdown. Since the chase aircraft has a faster approach speed, it must anticipate a closure rate when the lead aircraft attains on-speed AOA. If chase miscalculates the separation distance required and overtakes the lead aircraft, it will slow no slower than on-speed AOA +15 knots, maintain lateral separation to the lead aircraft/runway, and go no lower than 200 feet AGL. During go-around, chase will again position itself in the safety chase position. On downwind to a straight-in entry, the chase aircraft will assume the lead and Event 13 will be reaccomplished with the other aircraft in the photo chase position. The lead may full stop. If a touch-and-go is performed, a sequenced closed pattern should be requested. If approved, the lead should break to a closed downwind followed by the chase aircraft with adequate separation for landing. The formation is terminated at that point.

14. Debrief.

INSTRUMENTATION/DATA REDUCTION/REQUIRED PLOTS:

None.

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SECTION VI
VARIABLE STABILITY TRAINING

The Variable Stability Training consists of demonstration and evaluation flights in Calspan's Learjet 24 and the NF-16D VISTA aircraft. The purpose of these flights is to familiarize pilots and FTE/Ns with various aspects of aircraft flying qualities and handling qualities flight testing.

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VSS DEMO/EVAL FLIGHT 1 & 2 (PILOT)

REFERENCES:
Calspan Handouts

PURPOSE:
To familiarize pilots and FTE/Ns with various aspects of the longitudinal, lateral, and directional modes of aircraft motion, using a variable stability Learjet 24.

AIRCRAFT:
Calspan VSS Learjet 24

GENERAL:

1. These two-hour flights will demonstrate both longitudinal and lateral-directional modes of the aircraft. The final flight (flown if VISTA is not available) will be a review of previous concepts and an additional demonstration of control system characteristics.

2. Demonstrations will include the effects of short period frequency, damping, and control system characteristics on the longitudinal flying qualities, and the effects of frequency, damping, ϕ/β ratio, roll mode time constant changes, and lateral control characteristics on the lateral-directional flying qualities.

3. The student will be given practice in flying qualities evaluations at the end of each flight.

LIMITATIONS:
This mission will be flown within the constraints of Calspan's current Flight Manual Supplement for the Learjet 24 and Chapters 2 and 3 of Calspan Flight Syllabus and Background Material for USAF/USN TPS.

MISSION EVENTS:
These missions will be flown in accordance with the Calspan handout. The Calspan pilot may change the profile to better suit the circumstances at the time.

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VSS DEMO (FTE/N)

REFERENCES:
Calspan Handouts

PURPOSE:
To familiarize FTE/Ns with various aspects of the longitudinal, lateral and directional stability and modes of aircraft motion, using a variable stability Learjet 24.

AIRCRAFT:
Calspan VSS Learjet 24

GENERAL:
1. This flight will demonstrate both longitudinal and lateral-directional modes of the aircraft.

2. Demonstrations may include the effects of short period frequency, damping, and control system characteristics on the longitudinal flying qualities, and the effects of frequency, damping, ϕ/β ratio, roll mode time constant changes, and lateral control characteristics on the lateral-directional flying qualities.

LIMITATIONS:
This mission will be flown within the constraints of Calspan's current Flight Manual Supplement for the Learjet 24 and Chapters 2 and 3 of Calspan Flight Syllabus and Background Material for USAF/USN TPS.

MISSION EVENTS:
The mission will normally consist of selected events from the Flight 1, 2, 3 and 4 Syllabus missions as described in the Calspan handout.

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VISTA DEMO/EVAL FLIGHT (P/FTE/N)

REFERENCES:
Calspan Handouts

PURPOSE:
To familiarize pilots and FTE/Ns with various aspects of testing modern, highly augmented, aircraft.

AIRCRAFT:
VISTA NF-16D (As available)

GENERAL:
1. These 1.3 hour flights will include several advanced flight control system demonstration points and an up-and-away augmented aircraft evaluation exercise.

2. Demonstrations will include programmed test inputs, structural mode excitation, control surface rate limiting, direct lift control, and variations in engine response time.

3. A handling qualities evaluation will be done on a configuration representative of a highly augmented aircraft.

LIMITATIONS:
This mission will be flown within the constraints of the current F-16D 86-0048 Partial Flight Manual and Calspan's VISTA Flight Briefing Notes.

MISSION EVENTS:
This mission will be flown in accordance with the Calspan handout. The flight profile can be tailored by the Calspan pilot based on time and fuel constraints.

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VSS FLIGHT CONTROLS SYSTEMS (FCS) PROJECT (P/FTE/N)

REFERENCES:

1. Flying Qualities Textbook, Part III Flight Control Systems
2. Flight Control System Design Project Handouts.
3. Calspan Handouts.

PURPOSE:

Evaluate through flight test the flight control system that each group designed as part of the Flight Control System Design Project

AIRCRAFT:

VISTA NF-16D
Calspan VSS Learjet 24 (Optional)

GENERAL:

1. The students will use analysis, a selected handling qualities criteria, and a simulator to design their control system. After completing the design, Calspan will be given each group's design to implement in VISTA.

2. Students will conduct ground testing of their design in preparation for flight testing in the VISTA.

3. Each student group will flight test their design. This testing will include aero-servo-elastic and aerodynamic model validation testing in addition to Phase 1, 2, and 3 handling qualities evaluations.

LIMITATIONS:

1. Calspan will identify any design configurations that may cause problems in the VISTA NF-16D.

2. Prior to student flights, an evaluation flight with a TPS Staff Instructor Pilot will be performed to verify the controllability and safety of each design.

3. Aircraft limits will be IAW the Calspan Flight Control System Course Project handout and flight manual.

MISSION EVENTS:
This mission will be flown in accordance with FCS Project handouts and Calspan handouts.

SECTION VII
SIMULATOR TRAINING

The simulator training is spread throughout the flying qualities curriculum. Eight simulator sessions are planned during the flying qualities phase. Three different simulators are used, two are located in the Test Pilot School Building while the other simulator is located in the Test Evaluation Modeling and Simulation (TEMS) Lab.

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HANDLING QUALITIES EVALUATION SIMULATION

REFERENCES:

1. Flying Qualities Textbook, Supplementary Material
2. MIL-STD-1797A
3. MIL-F-83691B (USAF)

PREREQUISITES:

Handling qualities evaluation academics

PURPOSE:

1. To demonstrate and practice the use of rating scales and giving appropriate qualitative comments on aircraft handling qualities.

2. To practice using the correct terminology to describe aircraft motion.

3. To practice HQDT.

SIMULATOR:

R. Smith simulator at the TPS.

SESSION:

Individual student sessions will last approximately 1.5 hours each.

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DYNAMICS SIMULATION

REFERENCES:

1. Flying Qualities Textbook, Supplementary Material
2. MIL-STD-1797A
3. MIL-F-83691B (USAF)

PREREQUISITES:

Equations of motion academics

PURPOSE:

1. To demonstrate the aircraft modes of motion as derived in class using the equations of motion.

2. To reinforce the theory learned during the dynamics course and introduce the concept of model validation.

3. To practice using the correct terminology to describe aircraft motion.

SIMULATOR:

Veda simulator at the TPS.

SESSION:

Pilot/FTEN group sessions will last approximately 2.0 hours each. An overview of what will be completed in the simulator is listed below.

2nd order systems

Key time response characteristics

Effects of varying ζ and ω_n on time response

Effects of additional poles and zeros on time response

Relationahips between ζ, ω_n, and: flight condition

aircraft geometry

aircraft stability derivatives

Concept of analog time response matching and parameter estimation (PEST)

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AERODYNAMIC MODEL SIMULATION

REFERENCES:
1. Flying Qualities Textbook, Supplementary Material
2. MIL-STD-1797A
3. MIL-F-83691B (USAF)

PREREQUISITES:
Equations of motion academics

PURPOSE:
1. To demonstrate and practice the process of stability derivative estimation using PEST. Manual pitch doublets and Programed Test Inputs (PTI) will be the primary inputs to estimate the stability derivatives.

SIMULATOR:
TEMS

SESSION:
Pilot/FTEN group sessions will last approximately 2.0 hours each.

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FREQUENCY RESPONSE ANALYSIS SIMULATION

REFERENCES:

1. Flying Qualities Textbook, Supplementary Material
2. MIL-STD-1797A
3. MIL-F-83691B (USAF)

PREREQUISITES:

Frequency response analysis academics

PURPOSE:

1. To demonstrate and practice the process of frequency response estimation using PCFRA. Control sweeps and HQDT will be the primary inputs for estimating the frequency response.

SIMULATOR:

TEMS

SESSION:

Pilot/FTEN group sessions will last approximately 2.0 hours each.

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AERO SERVO-ELASTIC SIMULATION

REFERENCES:

1. Flying Qualities Textbook, Supplementary Material
2. MIL-STD-1797A
3. MIL-F-83691B (USAF)

PREREQUISITES:

Aero servo-elastic (ASE) academics

PURPOSE:

1. To demonstrate and practice aero servo-elastic testing while collecting data for student flight control system group projects.

SIMULATOR:

TEMS

SESSION:

Flight control system project group sessions will last approximately 2.0 hours each.

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FLIGHT CONTROL PROJECT SIMULATOR SESSIONS

REFERENCES:

1. Flying Qualities Textbook, Supplementary Material
2. MIL-STD-1797A
3. MIL-F-83691B (USAF)

PREREQUISITES:

Flight control system flight test academics

PURPOSE:

1. To demonstrate and practice the process of flight control system model validation testing. Handling qualities maneuvers will be the primary input for model validation testing.

SIMULATOR:

TEMS

SESSIONS:

Flight control system project group sessions will last approximately 4.0 hours each. Two 4.0 hour sessions per group will be scheduled.

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ENGINE OUT SIMULATOR

REFERENCES:

1. Flying Qualities Textbook, Supplementary Material
2. MIL-STD-1797A
3. MIL-F-83691B (USAF)

PREREQUISITES:

Failure state academics

PURPOSE:

1. To demonstrate and practice engine out handling qualities testing.
2. To demonstrate and practice V_{mca} determination testing.
3. To demonstrate V_{mcg}.

SIMULATOR:

TEMS

SESSIONS:

Pilot/FTEN group sessions will last approximately 2.0 hours each.

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APPENDIX A

GRADESHEETS

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USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

MISSION	CLASS	DATE
HANDLING QUALITIES DEMO PILOT		

STUDENT	INSTRUCTOR PILOT	AIRCRAFT TYPE/NO.	FLIGHT TIME	GRADE
		T-38/		

MISSION EVENTS
1. MISSION PREPARATION
2. BRIEF
3. PREFLIGHT/GROUND OPERATIONS
4. TAKEOFF (INTERVAL OR AIRBORNE PICKUP)
5. TRIM SHOT 15K, 400 KIAS
6. AIR TO AIR HQ TESTING (PHASE 1,2,3)
6A. 3G AND 4 G TURNS (IP DEMO/STUDENT PRACTICE)
6B. WINDUP TURN (STUDENT PRACTICE)
6C. REJOINS (IP DEMO AS REQ)
7. CLOSE FORMATION HQ TESTING (PH 1,2,3)
7A. 10K/350 KIAS, CR (IP DEMO/STUDENT PRACTICE)
7B. 10K/FINAL TURN AIRSPEED, PA (STUDENT PRACTICE)
8. AIR TO GROUND HQ TESTING (PH 1,2)--IP DEMO AS REQ
8A. 30 DEG DIVE DELIVERY (IP DEMO/STUDENT PRACTICE)
9. FORMATION APPROACH/FULL STOP
10. DEBRIEF
11. TARGET COORDINATION

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

AFSC FORM 5228a, OCT 86 REPLACES AFFTC FORM 255, NOV 84, WHICH WILL BE USED.

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ADDITIONAL COMMENTS

AFSC FORM 5228a, (Reverse)/OCT 86

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

STUDENT	INSTRUCTOR PILOT	MISSION LONG STAT / MAN FLT DEMO (PILOT)	CLASS	DATE
		AIRCRAFT TYPE/NO. T-38/	FLIGHT TIME	GRADE

MISSION EVENTS

1. MISSION PREPARATION
2. BRIEFING
3. GROUND BLOCK
4. TAKEOFF (MIL POWER)
5. TRIM SHOT 20K, 220 KIAS, CR
6. STABILIZED METHOD (250, 235, 205, 190) - IP DEMO
7. STABILIZED METHOD (250, 235, 205, 190) - STUDENT PRACTICE
8. STUDENT TRIM SHOT 20K, 350 KIAS, CR
9. ACCEL/DECEL METHOD ($\pm$50 KIAS) - IP DEMO
10. ACCEL/DECEL METHOD - STUDENT PRACTICE
11. TRIM SHOT 24K, 325 KIAS, CR
12. IP DEMO STABILIZED "G" METHOD, 22K, 325 KIAS
13. STABILIZED "G" METHOD - STUDENT PRACTICE
14. SLOWLY VARYING "G" METHOD, 22K, 325 KIAS - IP DEMO (OPTIONAL)
15. SLOWLY VARYING "G" METHOD - STUDENT PRACTICE
16. "PULLUP/PUSHOVER", 22K, 325 KIAS - STUDENT PRACTICE
17. SINUSOIDAL STICK PUMP, IP DEMO
18. SIMUSOIDAL STICK PUMP, STUDENT PRACTICE
19. FLIGHT PATH STABILITY (11K TO 9k) - IP DEMO
20. FLIGHT PATH STABILITY (11K TO 9K) (V_{omin}, -5, -10, +5 V_{omin}) - STUDENT PRACTICE
21. TRIM SHOT 9,500 FT, 175 KIAS, GEAR/FLAPS 60% (OPTIONAL)
22. STABILIZED "G" METHOD STUDENT PRACTICE (OPTIONAL)
23. PITCH TRIM CHANGES/LANDING
24. GROUND BLOCK
25. DEBRIEF

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

AFSC FORM 5228a, OCT 86 REPLACES AFFTC FORM 255, NOV 84, WHICH WILL BE USED.

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ADDITIONAL COMMENTS

AFSC FORM 5228a, (Reverse) OCT 86

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

STUDENT	INSTRUCTOR PILOT	MISSION LONG STAT / MAN FLT DEMO (FTE/N)	CLASS	DATE
		AIRCRAFT TYPE/NO. C-23/	FLIGHT TIME	GRADE

MISSION EVENTS
1. MISSION PREPARATION
2. BRIEFING
3. GROUND BLOCK
4. TAKEOFF/CLIMB
5. TRIM SHOT 8,000 FT, 120 KIAS
6. STABILIZED METHOD - IP DEMO/STUDENT PRACTICE
7. HAND-HELD FORCE GAUGE - IP DEMO/STUDENT PRACTICE
USING STABILIZED FTT
8. ACCEL/DECEL FTT - IP DEMO (V_{TRIM} ±15%)
9. TRIM SHOT 8,000 FT 135 KIAS
10. STABILIZED "G" METHOD DEMO/PRACTICE
11. SLOWLY VARYING 'G' METHOD DEMO/PRACTICE
12. "PULLUP" METHOD, 6-10K 120 KIAS - IP DEMO
13. FLIGHT PATH STABILITY - IP DEMO/STUDENT PRACTICE
A. VOMIN +5 (DEMO)
B. VOMIN +5, -5, -10, V_{OMIN} (PRACTICE)
14. LANDING
15. DEBRIEFING

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

AFSC FORM 5228a, OCT 86 REPLACES AFFTC FORM 255, NOV 84, WHICH WILL BE USED.

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AFSC FORM 5228a, (Reverse) OCT 86

ADDITIONAL COMMENTS

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

STUDENT	INSTRUCTOR PILOT	MISSION LAT-DIR DEMO(PILOT/FTEN)	CLASS	DATE
		AIRCRAFT TYPE/NO. C-23/	FLIGHT TIME	GRADE

MISSION EVENTS
1. MISSION PREPARATION
2. BRIEF
3. GROUND BLOCK
4. TAKEOFF/CLIMB
5. TRIM SHOT
A. 6-10K FT, 120 KIAS
6. AILERON ROLL FTT - IP DEMO/STUDENT PRACTICE
7. TURN COORDINATION
8. DIRECTIONAL CONTROL WITH SPEED CHANGE - P FACTOR
9. TRIM SHOT - PA CONFIGURATION
A. 6-10K FT, 100 KIAS/15° FLAPS
10. STABILIZED SHSS FTT - IP DEMO/STUDENT PRACTICE
11. SLOWLY VARYING SHSS FTT - IP DEMO/STUDENT PRACTICE
12. LANDING
13. TAXI
14. DEBRIEF

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

AFSC FORM 5228a, OCT 86 REPLACES AFFTC FORM 255, NOV 84, WHICH WILL BE USED.

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AFSC FORM 5228a, *(Reverse)*OCT 86

ADDITIONAL COMMENTS

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

MISSION	CLASS	DATE
DYNAMICS DEMO (PILOT)		

STUDENT	INSTRUCTOR PILOT	AIRCRAFT TYPE/NO. F-15/	FLIGHT TIME	GRADE

MISSION EVENTS
1. MISSION PREPARATION
2. BRIEFING
3. GROUND BLOCK
4. TAKEOFF
5. TRIM SHOT (20,000 FT MSL - 0.8M) (435 PSF)
6. SHORT PERIOD FTT
A. IP DEMO SHORT PERIOD (P CAS OFF)
B. STUDENT PRACTICE
7. BANK ANGLE OSCILLATION (20,000 FT MSL - 0.8M) (CAS ON / R/Y CAS OFF)
8. DUTCH ROLL MODE
A. IP DEMO (R/Y CAS OFF)
B. STUDENT PRACTICE (CAS ON / R, RY CAS OFF)
9. SPIRAL MODE - STUDENT PRACTICE (CAS ON/R CAS OFF)
10. TRIM SHOT (30,000 FT - 0.8M) (281 PSF)
11. PHUGOID - STUDENT PRACTICE (P CAS OFF, PITCH RATIO - EMERGENCY)
12. Q EFFECT - STUDENT PRACTICE
A. SHORT PERIOD (CAS ON/P CAS OFF)
B. DUTCH ROLL (CAS ON / R/Y CAS OFF)
13. SUPERSONIC EFFECTS STUDENT PRACTICE
A. TRIM 30,000 FT - 1.22 MACH (654 PSF)
B. SHORT PERIOD (CAS ON/P CAS OFF)
C. DUTCH ROLL (CAS ON / R/Y CAS OFF)
14. CAS EFFECTIVENESS - STUDENT PRACTICE
15. TRIM SHOT (10,000 FT, 0.8 IMN)
16. MACH NUMBER EFFECTS - STUDENT PRACTICE
A. TRIM 10,000 FT - 0.8 IMN (652 PSF)
B. SHORT PERIOD (CAS ON/P CAS OFF)
C. DUTCH ROLL (CAS ON / R/Y CAS OFF)
17. ROLL RATE OSCILLATIONS - STUDENT PRACTICE (10,000 FT - 160 KCAS) (CAS ON / R/Y CAS OFF)
18. DYNAMICS (10,000 FT, 160 KCAS, CR) - STUDENT PRACTICE
19. DYNAMICS (10,000 FT, 160 KCAS, PA) - STUDENT PRACTICE
20. SPOT LANDING, 21 AND 23 UNIT APPROACHES - STUDENT PRACTICE
21. DEBRIEFING

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

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ADDITIONAL COMMENTS

AFSC FORM 5228a, (Reverse)/OCT 88

USAF TEST PILOT SCHOOL STUDENT MISSION CARD/GRADE SHEET		MISSION FLYING QUALITIES DEMO (FTE/N)	CLASS	DATE
STUDENT	INSTRUCTOR PILOT	AIRCRAFT TYPE/NO. T-38/	FLIGHT TIME	GRADE

MISSION EVENTS	Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.
1. MISSION PREPARATION	**MISSION PREPARATION**
2. BRIEFING	
3. GROUND BLOCK - 1/2 STICK DEFLECTION CALIBRATION	
4. MIL/MAX POWER TAKEOFF	**FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING**
5. MILITARY POWER CLIMB 5 - 25K	
6. FLIGHT TEST TECHNIQUES	
A. TRIM SHOT 25K, 300 KIAS	
B. *LONG STAT STABILITY 25K, 300 KIAS, CRUISE	
CONFIGURATION (290, 280, 270, 310, 320, 330)	
C. *MANEUVERING FLIGHT 24K, 300 KIAS, CRUISE	
CONFIGURATION 30 DEGREES, 45 DEGREES, SLOWLY VARYING	
D. AILERON ROLLS 25K, 300 KIAS, CRUISE CONFIGURATION 45 DEGREES	
-45 DEGREES IN BOTH DIRECTIONS	
(1) *1/2 DEFLECTION	
(2) *FULL DEFLECTION AILERON ROLLS 25K, 300 KIAS, CRUISE	
E. DYNAMICS - 25K, 300 KIAS, CRUISE CONFIGURATION	
(1) *SHORT PERIOD - SINGLET, DOUBLET	
(2) *DUTCH ROLL - DAMPERS ON AND OFF	
F. *1G STALL 20K TRIM 220 KIAS, CRUISE CONFIGURATION	
(1) *NEAR STALL INVESTIGATION	
(2) *STALL INVESTIGATION	
(3) *RECOVERY	
(4) DEEP STALL INVESTIGATION	
G. OPERATIONAL HANDLING TASK - 30 DEGREES DIVE BOMB	
H. *SIDESLIP, 12K, 170 KIAS, PA CONFIGURATION, ONE	
DIRECTION, STABILIZED AND SLOWLY VARYING (AVOID RAPID YAW RATES)	
7. LANDING	
8. MISSION DEBRIEF	**AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)**
*AFTER THIS MANEUVER IS DEMONSTRATED, STUDENT WILL	
PRACTICE THE MANEUVER	
	INSTRUCTOR PILOT / SECTION CHIEF / CHIEF, OPERATIONS BR

AFSC FORM 5228a, OCT 86 REPLACES AFFTC FORM 255, NOV 84, WHICH WILL BE USED. USAF TPS/ED OVERPRINT H:\ACADEMIC\PPG\FQ\GRADESHT\FQDEMO.GS DATE: MAR 94

ADDITIONAL COMMENTS

AFSC FORM 5228a, (Reverse) OCT 86

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

STUDENT	INSTRUCTOR PILOT	MISSION MULTI-ENGINE DEMO (PILOT/FTEN)	CLASS	DATE
		AIRCRAFT TYPE/NO. C-141/	FLIGHT TIME	GRADE

MISSION EVENTS
1. BRIEFING
2. GROUND BLOCK
3. REDUCED EPR TAKEOFF AND NORMAL CLIMB (250 KCAS < 10K, 280 KCAS)
4. TRIM SHOT 15,000 FT, 250 KCAS
5. SPEED STABILITY:
A. ACCEL/DECEL (SLOWLY VARYING) FROM 290 TO 210 KCAS
6. MAN FLIGHT:
A. STABILIZED OR SLOWLY VARYING (MAX OF 60 DEG)
B. PULLUP/PUSHOVER (1.6G AND 0.5G)
7. TRIM SHOT (25K, 275 KCAS, CR)
A. SHORT PERIOD, (PHUGOID OPTIONAL)
B. DUTCH ROLL (YAW DAMPER ON AND OFF)
C. ROLL PERFORMANCE 15 TO 15 (1/4, 1/2, AND 3/4 DEFLECTION)
(THE 1/4 DEFLECTION DEMONSTRATES ROLL RATE OSCILLATION)
8 . AIR REFUELING HANDLING QUALITIES TESTING (25K, 275 KCAS)
A. PHASE 1 AND 2 (BOOM TRACKING)
B. PHASE 3 (SIMULATED AIR REFUELING)
9. LOW LEVEL/AIRDROP (500 FT AGL MIN)
10. TRIM SHOT (15K, VAPP + 20, PA)
A. STEADY HEADING SIDESLIP (STABILIZED OR SLOWLY VARYING)
B. APPROACH TO STALL, PA, 15,000 FT
C. FLIGHT PATH STABILITY 11,000 FT TO 9,000 FT, 75% FLAPS (OPTIONAL)
11. TOUCH AND GO PATTERNS/TACTICAL APPROACHES
12. OFFSET LANDING TASK
13. FULL STOP
14. GROUND BLOCK
15. DEBRIEF
FTE/N - MAY FLY SOME POINTS UP AND AWAY TIME PERMITTING

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

AFSC FORM 5228a, OCT 86 REPLACES AFFTC FORM 255, NOV 84, WHICH WILL BE USED.

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ADDITIONAL COMMENTS

AFSC FORM 5228a, (Reverse) OCT 86

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

MISSION AERO MODEL VALIDATION PILOT (FTEN--TM)	CLASS	DATE
AIRCRAFT TYPE/NO. F-16/	FLIGHT TIME	GRADE

STUDENT	INSTRUCTOR PILOT

MISSION EVENTS
1. MISSION PREPARATION
2. BRIEF
3. PREFLIGHT/GROUND OPERATIONS
4. MIL/MAX POWER TAKEOFF
5. AIRBORNE SI CHECK
6. TRIM SHOT 17K, 0.58M, CR
7. HANDLING QUALITIES INVESTIGATION (PHASE 1/2/3)/LEAD CHANGE
8. 1G PITCH DOUBLET, IP DEMO
9. 1G PITCH DOUBLET, STUDENT PRACTICE
10. 1G YAW-ROLL DOUBLET, IP DEMO
11. 1G YAW-ROLL DOUBLET, STUDENT PRACTICE
12. 2G PITCH DOUBLET, STUDENT PRACTICE
13. 2G YAW-ROLL DOUBLET, STUDENT PRACTICE
14. PITCH FREQUENCY SWEEP, IP DEMO
15. PITCH FREQUENCY SWEEP, STUDENT PRACTICE
16. ROLL FREQUENCY SWEEP, IP DEMO
17. ROLL FREQUENCY SWEEP, STUDENT PRACTICE
18. YAW FREQUENCY SWEEP, IP DEMO
19. YAW FREQUENCY SWEEP, STUDENT PRACTICE
20. LAND
21. DEBRIEFING
22. TM COORDINATION

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

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AFSC FORM 5228a, *(Reverse)* OCT 86

ADDITIONAL COMMENTS

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

STUDENT	INSTRUCTOR PILOT	MISSION GLIDER FQ DEMO	CLASS	DATE
		AIRCRAFT TYPE/NO. GROB 103/ASK 21	FLIGHT TIME	GRADE

MISSION EVENTS

1. MISSION PREPARATION/PREFLIGHT
2. TAKEOFF AND AEROTOW (3000' AGL)
   A. CONTROL HARMONY
   B. BOX WASH
   C. "T" TAIL PIO DEMO
   D. RELEASE
3. LATERAL-DIRECTIONAL
   A. TURN COORDINATION
   B. SPIRAL STABILITY
   C. SPIRAL TURN
   D. ROLL PERFORMANCE
   E. STEADY HEADING SIDESLIPS
4. STALLS
   A. PHASE A STALL (1KT/SEC)
   B. PHASE B STALL (1KT/SEC)
   C. PHASE B STALL (5KT/SEC)
5. DYNAMICS
   A. DUTCH ROLL
   B. PHUGOID
   C. PITCH TRIM CHANGES (SPOILERS)
6. THERMALLING DEMO
7. PATTERN AND LANDING

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

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ADDITIONAL COMMENTS

AFSC FORM 5228a, *(Reverse)* OCT 86

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

STUDENT	INSTRUCTOR PILOT	MISSION OPS HANDLING DEMO (PILOT)	CLASS	DATE
		AIRCRAFT TYPE/NO. T-38/	FLIGHT TIME	GRADE

MISSION EVENTS
1. MISSION PREPARATION
2. BRIEFING
3. PREFLIGHT/GROUND BLOCK
4. A/B TAKEOFF
5. JOINUP
6. FORMATION
A. FINGERTIP
B. CROSSUNDERS
C. REJOINS
D. TACTICAL
7. CHANGE LEADS AND REPEAT 6 A-D
8. OERATIONAL HANDLING TASK, IP DEMO 15K, 350 KIAS (AIR-TO-AIR TRACKING)
9. OPERATIONAL HANDLING TASK, STUDENT PRACTICE (AIR-TO-AIR TRACKING)
10. CHANGE LEADS AND REPEAT 8 & 9
11. OPERATIONAL HANDLING TASK, IP DEMO (AIR-TO-GROUND TRACKING)
12. OPERATIONAL HANDLING TASK, STUDENT PRACTICE (AIR-TO-GROUND TRACKING)
13. OFFSET APPROACH
14. SPOT LANDING (OPTIONAL)
15. GROUND BLOCK
16. DEBRIEF

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

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ADDITIONAL COMMENTS

AFSC FORM 5228a, *(Reverse)* OCT 86

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

STUDENT	INSTRUCTOR PILOT	MISSION FQ CHECK FLT EVAL P/FTE/N	CLASS	DATE
		AIRCRAFT TYPE/NO. T-38/	FLIGHT TIME	GRADE

MISSION EVENTS	
1. MISSION PREPARATION	20
A. MISSION DEFINITION	
B. TEST OBJECTIVES DEFINITION	
C. TEST ENVELOPE DEFINITION	
D. FUEL CONSIDERATIONS	
E. AREA CONSIDERATIONS	
F. SAFETY CONSIDERATIONS	
2. MISSION BRIEFING	20
A. SPECIFIC MISSION BRIEF	
B. FTT CHOICE/DESCRIPTION	
C. MIL STD RELATION	
3. DATA CARDS	10
A. LEGIBLE	
B. COMPREHENSIVE	
C. CONCISE	
4. AIRBORNE CONDUCT	30
A. FLIGHT PERFORMANCE	
(1) FTT (PILOT)	
(2) MISSION DIRECTION (FTE/N)	
B. RESOURCE MANAGEMENT	
(1) TIME	
(2) FUEL	
(3) ENERGY	
C. INFLIGHT DECISIONS	
(1) DELIBERATE ACTIONS TO CONTROL TEST	
(2) ABILITY TO ADAPT TO CHANGES	
(3) SHOW EVIDENCE OF PRIORITIES	
5. DEBRIEF	20
A. INTERPRETATION OF DATA	
B. RECOGNITION OF DATA QUALITY	

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

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ADDITIONAL COMMENTS

AFSC FORM 5228a, *(Reverse)*OCT 86

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

MISSION ENGINE OUT DEMO/DATA (PILOT/FTEN)	CLASS	DATE	
STUDENT	INSTRUCTOR PILOT	AIRCRAFT TYPE/NO. C-141/	FLIGHT TIME	GRADE

MISSION EVENTS	
1. MISSION PREPARATION	
2. BRIEF	
3. ENGINE START	
4. GROUND BLOCK	
5. NORMAL TAKEOFF	
6. CLIMB TO 11,000 FEET	
7. TRIM SHOT - 11,000 FT, 155 KCAS, TO	
A. RECORD β	
8. EFFECT OF BANK ANGLE (11,000 $\pm$ 1,000 FT, #1 AND 2 MRT, #3 AND 4 IDLE)	
A. $\phi = 0$	
B. ϕ FOR $\beta = 0$	
C. ϕ FOR $F_R = 0$	
D. INCREASE ϕ (2 TO 3°) BEYOND $F_R = 0$ PT	
E. SMALL ϕ INTO FAILED ENGINES (ϕ < 5 DEGREES)	
9. 1G APPROACH TO STALL (11,000 FT, TO, TLF)	
A. 4-ENGINE	
B. 3-ENGINE	
10. STATIC V_{MCA} DETERMINATION - CONSTANT V (11,000 $\pm$ 1,000 FT, V_{SHO} +15,	
REDUCE #1 AND #2, INCREASE #3 AND #4)	
11. STATIC V_{MCA} DETERMINATION - VARYING V (7,500 ±500 FT, 155 KCAS, TO,	
#1 MRT, #4 SHUTDOWN)	
A. ϕ=0°	
B. (SWITCH PILOTS) ϕ=5°	
12. DYNAMIC EFFECTS ON V_{MCA} (7,500 FT, V_{MCA} OR V_{SHO} +5, TO, #4 IDLE)	
13. REPEAT #10 AT 8,000 ± 500 FT	
14. ENGINE-OUT APP AND GA (8,500 FT, V_{APP}, GEAR, FLAPS-LDG, #1 IDLE)	
15. ENGINE-OUT CLIMB PERFORMANCE (8,500-9,500 FT, GEAR-UP, FLAPS-APP, #1 IDLE)	
(OPTIONAL) A. V_{MCO}, ϕ=0° B. V_{MCO}, ϕ=5° C. V_{MCO}, β=0°	
16. PATTERNS (PALMDALE OR EDWARDS)	
A. ENGINE FAILURE ON TAKE-OFF	
B. ENGINE-OUT PATTERN/GO-AROUND	
C. ENGINE-OUT/TWO ENGINE-OUT LANDING (OPTIONAL)	
17. DEBRIEF	

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

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AFSC FORM 5228a (Reverse) OCT 86

ADDITIONAL COMMENTS

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

STUDENT	INSTRUCTOR PILOT	MISSION C-23 FLYING QUALITIES DEMO (PILOT/FTE/N)	CLASS	DATE
		AIRCRAFT TYPE/NO. C-23A	FLIGHT TIME	GRADE

MISSION EVENTS

1. MISSION PREPARATION
2. BRIEF
3. TAKEOFF
4. 500' AGL LOW LEVEL
5. SIDEWASH DEMO
6. 'P' FACTOR DEMO
7. TORQUE EFFECT DEMO
8. APPROACH TO STALL, 1G
9. SIM SINGLE ENGINE SLOW FLIGHT
10. PATTERN WORK
11. DEBRIEF

NOTE: STUDENTS WILL SWAP SEATS TO ALLOW EACH TO SEE ALL OF THE DEMO POINTS

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

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AFSC FORM 5228a, (Reverse)OCT 86

ADDITIONAL COMMENTS

USAF TEST PILOT SCHOOL STUDENT MISSION CARD/GRADE SHEET		MISSION NEAR STALL/STALL DEMO (PILOT/FTEN)	CLASS	DATE
STUDENT	INSTRUCTOR PILOT	AIRCRAFT TYPE/NO. A/T-38A/B	FLIGHT TIME	GRADE

MISSION EVENTS

1. MISSION PREPARATION
2. BRIEF
3. GROUND BLOCK
4. TAKEOFF/CLIMB
5. TRIM SHOT 20,000 FT, 230 KIAS (CR)
6. FLYING QUALITIES NEAR STALL - 1G (CR)
7. TRIM SHOT 20,000 FT, 200 KIAS
8. STALL - 1G (CR) (1 KT/SEC)
   A. IP DEMO
   B. STUDENT PRACTICE
9. HIGH BLEED RATE STALL, 1G (CR) (5 KT/SEC)
10. LIFT BOUNDARY DETERMINATION 20,000 FT, 250 KIAS (CR)
11. FULL AFT STICK STALL DEMO (CR)
12. TRIM SHOT 20,000 FT, 280 KIAS
13. FLYING QUALITIES NEAR STALL, 2G (CR)
   A. IP DEMO
   B. STUDENT PRACTICE
14. TRIM SHOT 20,000 FT, 240 KIAS
15. STALL, 2G (CR)
   A. IP DEMO
   B. STUDENT PRACTICE
16. PHASE A STALL
17. TRIM SHOT 18,000 FT, 180 KIAS (PA)
18. STALL AND STALL WARNING PRACTICE
   A. PILOT PRACTICE STALL 1G (PA)
   B. PILOT PRACTICE STALL 1.4G (PA)
19. FTE/N PRACTICE (OPTIONAL)
20. SFO/NORMAL LANDING
21. GROUND BLOCK
22. DEBRIEF

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

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ADDITIONAL COMMENTS

AFSC FORM 5228a, *(Reverse)*OCT 86

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

STUDENT	INSTRUCTOR PILOT	MISSION GLIDER SPIN DEMO	CLASS	DATE
		AIRCRAFT TYPE/NO. ASK-21/	FLIGHT TIME	GRADE

MISSION EVENTS
1. PREPARATION, BRIEF AND PREFLIGHT
2. TAKEOFF AND AEROTOW (4000' AGL)
A. BOX WASH (OPTIONAL)
B. PRE-SPIN CHECKLIST
C. RELEASE
3. SPECIFIC MISSION PROFILES
A. FLIGHT 1 (NO TAIL WEIGHTS)
(1) PHASE A STALL
(2) PHASE B STALL (RH)
(3) PHASE C STALL (RH), NASA NEU RECOVERY
(4) SPINS
(A) THERMALLING ENTRY (RH) (IP DEMO)
(B) 1G ENTRY, 2 TURNS (RH), FLT MAN RECOVERY
(5) LOOP
B. FLIGHT 2 (16" CG)
(1) PHASE A STALL
(2) PHASE B STALL (RH)
(A) 1G ENTRY, 2 TURNS (RH), FLT MAN RECOVERY (IP DEMO)
(B) 1G ENTRY, 3 TURNS (LH), NASA STD RECOVERY
C. FLIGHT 3 (16" CG)
(1) PHASE C STALL (RH), NASA NEU RECOVERY
(2) SPINS
(A) 1G ENTRY, 2 TURNS (RH), NASA MOD RECOVERY
(B) 1G ENTRY, 3 TURNS (LH) W/AIL EFFECTS, FLT MAN RECOVERY
4. THERMALLING PRACTICE RECOVERY
5. PATTERN AND LANDING
6. DEBRIEFING

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

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AFSC FORM 5228a, (Reverse)/OCT 86

ADDITIONAL COMMENTS

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

MISSION	CLASS	DATE
SPIN DEMO (PILOT/FTEN)		

STUDENT	INSTRUCTOR PILOT	AIRCRAFT TYPE/NO. T-2/	FLIGHT TIME	GRADE

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION EVENTS
1. MISSION PREPARATION
2. BRIEFING
3. GROUND PROCEDURES
4. TAKEOFF
5. CLIMB
6. PRE-SPIN CHECKLIST
7. PHASE A STALL (1G, 2G & WUT)
8. PHASE B STALL
9. PHASE C STALL
10. PHASE D STALL (POST STALL GYRATIONS)
A. BASELINE UPRIGHT SPIN/NATOPS RECOVERY
B. INVERTED SPIN/NATOPS (NEUTRAL) RECOVERY
C. ELEVATOR EFFECTS/FULL AFT STICK RECOVERY
D. AILERON EFFECTS/AILERON INTO W/FULL AFT STICK RECOVERY
E. CONTROL FLOAT (POST STALL GYRATIONS)/HANDS-OFF RECOVERY
F. INERTIA-COUPLED DEPARTURE/NEUTRAL RECOVERY
G. DATA EVENT DEMO
11. RTB
12. SFO
13. PATTERN AND LANDING
14. DEBRIEFING

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

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ADDITIONAL COMMENTS

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

MISSION	CLASS	DATE
SPIN DATA (PILOT)		

STUDENT	INSTRUCTOR PILOT	AIRCRAFT TYPE/NO.	FLIGHT TIME	GRADE
		T-2/		

MISSION EVENTS
1. MISSION PREPARATION
2. BRIEFING
3. GROUND PROCEDURES
4. TAKEOFF
5. CLIMB
6. PRE-SPIN CHECKLIST
7. PHASE A/B/C STALLS
8. SPINS - AS REQUIRED FOR SPIN EXERCISE
A.
B.
C.
D.
E.
F.
G.
H.
9. RECOVERIES - AS REQUIRED FOR SPIN EXERCISE
A. FLIGHT MANUAL
B.
C.
D.
E.
10. RTB
11. SFO
12. PATTERN AND LANDING
13. DEBRIEFING

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

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ADDITIONAL COMMENTS

AFSC FORM 5228a, (Reverse)/OCT 86

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

MISSION SPIN TM (FTE/N)	CLASS	DATE
AIRCRAFT TYPE/NO. T-2/TM	FLIGHT TIME	GRADE

STUDENT	INSTRUCTOR FTE/N

MISSION EVENTS
1. MISSION PREPARATION
2. MISSION BRIEFING
A. CREW COORDINATION PROCEDURES (AIR-TO-GROUND COMMUNICATION)
3. TM TEST CONDUCT
A. COMMUNICATION
(1) RADIO CALLS
(2) QUALITATIVE/QUANTITATIVE FEEDBACK
B. MISSION CONDUCT
(1) KNOWLEDGE OF SPIN ENTRY PROCEDURES
(2) KNOWLEDGE OF SPIN RECOVERY PROCEDURES
(3) LIMIT MONITORING
C. DATA ACQUISITION
D. RESOURCE MANAGEMENT
E. TIME/FUEL/SITUATION AWARENESS
4. DEBRIEFING

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

CLEARED FOR SOLO TM? YES OR NO

INSTRUCTOR FTE/N	SECTION CHIEF	CHIEF, OPERATIONS BR

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ADDITIONAL COMMENTS

AFSC FORM 5228a, *(Reverse)*OCT 86

USAF TEST PILOT SCHOOL STUDENT MISSION CARD/GRADE SHEET		MISSION F-16 DEPARTURE DEMO (PILOT/FTE/NAV)	CLASS	DATE
STUDENT	INSTRUCTOR PILOT	AIRCRAFT TYPE/NO. F-16/	FLIGHT TIME	GRADE

MISSION EVENTS	
1. MISSION PREPARATION	
2. BRIEFING	
3. GROUND PROCEDURES	
4. TAKEOFF	
5. CLIMB	
6. PRE-DEPARTURE CHECKS	
7. DEPARTURES	
A. IP DEMO: 1G AOA ROLL, MAXIMUM G ROLL, ERECT 60° DEPARTURE	
B. 1G AOA ROLLS	
C. MAXIMUM G ROLLS	
D. AOA EXCURSION	
E. ERECT 60° DEPARTURES	
F. INVERTED 60° DEPARTURES	
G. PITCH RATE DEPARTURE	
H. TACTICAL PITCH RATE DEPARTURE	
I. ROLL COUPLED DEPARTURES	
8. RECOVERIES	
9. DEPARTURE PATTERN	
10. RTB	
11. PATTERN AND LANDINGS	
12. DEBRIEFING	

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

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ADDITIONAL COMMENTS

AFSC FORM 5228a, *(Reverse)*OCT 86

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

STUDENT	INSTRUCTOR PILOT	MISSION FORMATION AND CHASE FAM (MULTI PILOT)	CLASS	DATE
		AIRCRAFT TYPE/NO. T-38/	FLIGHT TIME	GRADE

MISSION EVENTS

1. MISSION PREPARATION
2. BRIEFING
3. PRE-FLIGHT/GROUND OPERATIONS
4. AIRBORNE PICKUP
5. JOIN UP
6. SAFETY CHECK
7. FORMATION (LEAD AND WING)
   - A. CLIMBS AND DESCENTS
   - B. TURNS/LAZY EIGHTS
   - C. CROSS-UNDERS
   - D. REJOINS/ADVANCED REJOINS
   - E. CONFIGURATION CHANGES
   - F. CLOSE TRAIL (OPTIONAL)
8. SAFETY CHASE (LEAD AND WING)
   - A. 1G MIL ACCEL/IDLE DECEL, 20,000 FT, 300 KIAS - 400 KIAS - 350 KIAS (OPTIONAL)
   - B. MIL POWER P_s=0, 18,000 FT, 350 KIAS
   - C. SLOW FLIGHT/APPROACH TO STALL
9. PHOTO CHASE (LEAD AND WING)
   - A. ROLL-IN DELIVERY (DEMO/PRACTICE)
   - B. PUSHOVER DELIVERY (OPTIONAL)
10. LEAD CHANGE (REPEAT 7-9)
11. RTB
12. PHOTO CHASE TOUCH AND GO
13. LEAD CHANGE
14. PHOTO CHASE TOUCH AND GO/FULL STOP
15. DEBRIEF

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

AFSC FORM 5228a, (Reverse) OCT 86

ADDITIONAL COMMENTS

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

STUDENT	INSTRUCTOR PILOT	MISSION FORMATION AND CHASE FAM (PILOT)	CLASS	DATE
		AIRCRAFT TYPE/NO. F-16B/	FLIGHT TIME	GRADE

MISSION EVENTS	
1. MISSION PREPARATION	
2. BRIEFING	
3. PREFLIGHT/GROUND OPERATIONS	
4. AIRBORNE PICKUP	
5. JOIN UP	
6. SAFETY CHECK	
7. FORMATION (LEAD AND WING)	
A. CLIMBS AND DESCENTS	
B. TURNS/LAZY EIGHTS	
C. CROSS-UNDERS	
D. CLOSE TRAIL (OPTIONAL)	
8. SAFETY CHASE (LEAD AND WING)	
A. AB ACCEL/IDLE DECEL 20,000 FT, 250 KIAS -	
0.95M - 350 KIAS (CHASE AT MIL)	
B. MIL POWER P_s=0, 20,000 FT, 350 KIAS (OPT)	
C. MANEUVERING FLIGHT, 20,000 FT, 350 KIAS	
D. 1G LIMITER DECEL, 20,000 FT, 200 KIAS	
9. ADVANCED REJOINS	
10. PHOTO CHASE (LEAD AND WING)	
A. PUSHOVER WEAPONS DELIVERY	
B. ROLL-IN DELIVERY (OPTIONAL)	
C. FLIP-FLOP (OPTIONAL)	
D. LOFT DELIVERY (OPTIONAL)	
E. ROLL-IN DELIVERY (OPTIONAL)	
11. LEAD CHANGE	
12. RTB AND PHOTO CHASE LANDINGS	
A. STRAIGHT-IN APPROACH	
B. OVERHEAD PATTERN	
13. DEBRIEFING	

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

AFSC FORM 5228a, OCT 86 REPLACES AFFTC FORM 255, NOV 84, WHICH WILL BE USED.

USAF TPS/ED OVERPRINT H:\ACADEMIC\PPG\FQ\GRADESHT\FRMFAM.GS DATE: MAR 95

AFSC FORM 5228a, *(Reverse)* OCT 86

ADDITIONAL COMMENTS

USAF TEST PILOT SCHOOL STUDENT MISSION CARD/GRADE SHEET		MISSION PHOTO/SAFETY CHASE	CLASS	DATE
STUDENT	INSTRUCTOR PILOT	AIRCRAFT TYPE/NO. F-16B/	FLIGHT TIME	GRADE

MISSION EVENTS
1. MISSION PREPARATION
2. BRIEFING
3. MIL PWR TAKEOFF
4. AB LITE (6 - 8k/350 - 400 KIAS)
5. CONFIGURATION CHANGE, 15K - GEAR AND FLAPS
6. LEVEL ACCEL/DECEL (230 KIAS - 400 KIAS - 350 KIAS/15K)
7. CLIMB TO FL 320/350 KIAS/0.9M/850° EGT
8. LEVEL ACCEL TO 1.3M/4G DECEL TO 0.9M (32K)
9. 0.8M DESCENT (28K TO 18K)
10. LOFT DELIVERY (12K/450/4Gs)
11. 1G LIMITER DECEL (22K)
12. MANEUVERING FLIGHT (15K/350 KIAS)
13. PUSHOVER DELIVERY (10K/450 KIAS)
14. ROLL-IN DELIVERY (10K/450 KIAS)
15. SFO PATTERN/TOUCH AND GO
16. STRAIGHT-IN/TOUCH AND GO
17. DEBRIEF

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

AFSC FORM 5228a, OCT 86 REPLACES AFFTC FORM 255, NOV 84, WHICH WILL BE USED.

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ADDITIONAL COMMENTS

AFSC FORM 5228a, *(Reverse)*OCT 86

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

MISSION	CLASS	DATE
PHOTO/SAFETY CHASE		

STUDENT	INSTRUCTOR PILOT	AIRCRAFT TYPE/NO.	FLIGHT TIME	GRADE
		T-38/		

MISSION EVENTS
1. MISSION PREPARATION
2. BRIEFING
3. TAKEOFF/AIRBORNE PICKUP (PHOTO GEAR)/SAFETY CHECK
4. AB LIGHT/CLIMB TO 15K (PHOTO NOZZLE)
5. CONFIGURATION CHANGE (PHOTO GEAR & FLAPS)
6. LEVEL ACCEL/DECEL (PHOTO STORE VIBRATION)
7. CLIMB TO FL 320 (SAFETY CHASE)
8. LEVEL ACCEL TO 1.3M/4G DECEL TO 0.9M (SAFETY CHASE)
9. 0.8M DESCENT (PHOTO STORE VIBRATION)
10. LOFT DELIVERY (PHOTO STORE SEPARATION)
11. 1G LIMITER DECEL (PHOTO RUDDER)
12. MANEUVERING FLIGHT (PHOTO CHASE)
13. PUSHOVER WEAPON DELIVERY (PHOTO STORE SEPARATION)
14. ROLL-IN DELIVERY (PHOTO STORE SEPARATION)
15. SFO PATTERN/TOUCH AND GO (PHOTO TOUCHDOWN)
16. STRAIGHT-IN/TOUCH AND GO (PHOTO TOUCHDOWN)
17. DEBRIEF

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

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AFSC FORM 5228a, (Reverse)OCT 86

ADDITIONAL COMMENTS

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

MISSION	CLASS	DATE
SPIN CHASE		

STUDENT	INSTRUCTOR PILOT	AIRCRAFT TYPE/NO. T-38/	FLIGHT TIME	GRADE

MISSION EVENTS
1. MISSION PREPARATION
2. BRIEFING
3. START/TAXI
4. TAKEOFF/AIRBORNE PICKUP
5. PHASE A/B CHASE
6. PHASE C CHASE
7. SPIN CHASE
A. ENTRY
B. CHASE POSITION
C. FUEL/ENERGY MANAGEMENT
8. REJOINS OUT OF SPIN
9. RTB REJOIN
10. SFO CHASE
11. SPOT LANDING
12. DEBRIEF

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

CLEARED FOR SOLO CHASE? YES OR NO

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

AFSC FORM 5228a, OCT 86 REPLACES AFFTC FORM 255, NOV 84, WHICH WILL BE USED.

USAF TPS/ED OVERPRINT H:\ACADEMIC\PPG\FQ\GRADESHT\SPCHASE.GS DATE: MAR 94

ADDITIONAL COMMENTS

AFSC FORM 5228a, *(Reverse)* OCT 86

USAF TEST PILOT SCHOOL
STUDENT MISSION CARD/GRADE SHEET

MISSION SUPERSONIC CHASE DEMO	CLASS	DATE		
STUDENT	INSTRUCTOR PILOT	AIRCRAFT TYPE/NO. F-15/F-16	FLIGHT TIME	GRADE

MISSION EVENTS

1. MISSION PREPARATION
2. BRIEFING
3. MIL/MAX POWER TAKEOFF (AIRBORNE PICKUP)
4. JOIN UP
5. SAFETY CHECK
6. MIL POWER CLIMB
7. ENTER SUPERSONIC CORRIDOR
   A. ACCELERATE TO 1.2 MACH
8. CHASE INVESTIGATES SHOCK WAVES
   A. CHASE CHECKS LEAD - LEVEL
   B. CHASE CHECKS LEAD - UNDERNEATH
9. LEAD INVESTIGATES SHOCK WAVES
10. 4G DECELERATING TURN
11. PHOTO CHASE PRACTICE
   A. 30° ROLL-IN SIMULATED WEAPONS RELEASE
   B. FLIP-FLOP (OPTIONAL)
   C. 45° ROLL- IN DELIVERY (OPTIONAL)
   D. LOFT (OPTIONAL)
12. DESCENT
13. PHOTO CHASE/LANDING
14. DEBRIEF

Comment on the following areas. (Expand on any area that is particularly strong or below average/unsatisfactory.) Continue on reverse side if necessary.

MISSION PREPARATION

FLIGHT TEST TECHNIQUES/DATA PROCEDURES/AIRCRAFT HANDLING

AIRMANSHIP (PLANNING/SAFETY/PROCEDURAL KNOWLEDGE)

INSTRUCTOR PILOT	SECTION CHIEF	CHIEF, OPERATIONS BR

AFSC FORM 5228a, OCT 86 REPLACES AFFTC FORM 255, NOV 84, WHICH WILL BE USED.

USAF TPS/ED OVERPRINT H:\ACADEMIC\PPG\FQ\GRADESHT\SSCHASE.GS DATE: MAR 94

AFSC FORM 5228a, *(Reverse)*OCT 86

ADDITIONAL COMMENTS

APPENDIX B

SAFETY REVIEW BOARD

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7-02

TEST [PRO]JECT SAFETY REVIEW (INITIAL AND AMENDM[EN]T)

(Refer to AFFTCR 127-3 for complete instructions)

I. PROJECT INFORMATION

PROJECT TEST TITLE	INITIAL RISK LEVEL	CONTROL NUMBER	TEST AGENCY
Test Pilot School Flying Qualities Phase	LOW	94-31	USAF TPS
SUBJECT OF AMENDMENT	AMENDMENT RISK LEVEL	CHANGE NUMBER	PROJECT JON
			P9307000

	SIGNATURE	PHONE NUMBER	DATE
PROJECT MANAGER (Typed Name and Grade) Ronald G. Joseph, Major	R Joseph	7-2348	27 May 94
UNIT TSO (Typed Name and Grade) James A. Esch, Captain	James A. Esch	7-8038	24 MAY 94

II. SAFETY REVIEW MEMBERS

	NAME, GRADE, AND TITLE	SIGNATURE AND DATE		NAME, GRADE, AND TITLE	SIGNATURE AND DATE
a.	David A. Lazerson, Civ SRB Chairman	David A Lazerson 26 MAY 94	f.		
b.	Robert Wilson, Maj Fighter Representative	Robert A Wilson 26 MAY 94	g.		
c.	Richard Gertz, Capt Multi Representative	Richard B. Gertz 31 MAY 94	h.		
d.	Robert Lee, Civ DOE Representative	Robert E Lee 2 JUNE 94	i.		
e.			j.		

III. COORDINATION AND APPROVAL

POSITION TITLE	SIGNATURE	DATE	ACTION (COORD, APPROVE, INFO, OR N/A)	COMMENTS ADDED YES	COMMENTS ADDED NO
TEST SAFETY OFFICER AFFTC/SET	David A. Lazerson	7 June 94	COORD	✓ FROM MAJ WILSON	
DIRECTOR OF SAFETY AFFTC/SE	Will R Stewart	8 June 94	COORD		✓
SQUADRON COMMANDER OR EQUIVALENT USAF TPS/ED	James M Payne	1994 JUN 10	COORD		✓
TEST WING ENGINEERING OR EQUIVALENT 412 TW/OGE	[illegible] Wood	15 June	COORD		✓
GROUP COMMANDER OR EQUIVALENT USAF TPS/CC	[illegible]	7 JUL 94	APPROVE		✓
GROUP COMMANDER OR EQUIVALENT N/A			N/A		
TEST WING COMMANDER OR EQUIVALENT [41]2 TW/CC	T. McFarland	9 Jul 94	INFO		✓
AFFTC COMMANDER (OR AS DELEGATED) AFFTC/CC	[illegible]	12 JUL 94	INFO		✓

RETURN TO AFFTC/SET

AFFTC FORM 5028 APR 93 (EF) Replaces AFFTC Forms 5028, Sep 89, and 5028b, Feb 91, which will not be used

IV PROJECT DESCRIPTION

INSTRUCTIONS: Include the following sections: Bac-- -ound, Test Objectives, Test Item Description, System Matu-- -, Types of Tests, Differences from Previous Tests and Scope. An amendment will incorporate changes inherent within these sections. Use additional sheets if necessary,

V. SAFETY REVIEW SUMMARY

INSTRUCTIONS: Include the following sections: Review Synopsis, References, Mishap Responsibilities, General Minimizing Considerations, Special Considerations, Action Items, Risk Assessment, and Coordination Comments. An amendment will incorporate changes inherent within these sections. Use additional sheets if necessary.

SECTION IV: PROJECT DESCRIPTION

1. Background: The flying qualities phase of instruction is part of the formal training provided by the USAF Test Pilot School(TPS).

2. Test Objectives: Teach student test pilots, flight test engineers, and test navigators the principles and techniques used during flying qualities testing of aircraft.

3. Test Item Description: Flying qualities test techniques are taught in the A-37, C-23, C-141, F-15, F-16, T-38, Calspan's VSS Learjet 24 and gliders (Grob 103, Blanik L-13, and ASK-21). Students evaluate either the F-15, F-16, T-38, or the C-141 aircraft at conditions listed in the respective Limited Flying Qualities Test Plan.

4. System Maturity: Curriculum aircraft are all mature systems that are currently operational. All maneuvers flown in the Flying Qualities Phase are evaluated by an IP prior to student training.

5. Types of Test to be Performed: This testing incorporates all aspects of an aircraft's stability characteristics, control system design and pilot-in-the-loop handling qualities. All classical flying qualities flight test techniques are demonstrated and performed as discussed in the Flying Qualities Phase Planning Guide. The flying qualities phase also includes the photo/safety chase, high angle of attack (AOA) and the F-16 deep stall portions of the TPS curriculum.

6. Differences from Previous Test: This package incorporates all amendments to the previous safety package and deletes those portions of the previous package that pertained to aircraft that are no longer used.

7. Scope: Approximately 29 different types of sorties are contained in the Flying Qualities Phase.

SECTION V: SAFETY REVIEW SUMMARY

1. Review Synopsis:

TRB: The TPS Flying Qualities Phase Planning Guide (March 1994 edition) and associated student test plans (April 1994 edition) were reviewed and approved by the TPS staff and Commandant. The guides and plans were found to be technically adequate to meet the objectives of this phase of instruction.

SRB: A safety review board was convened on 3 May 1994 to review the revised Flying Qualities Phase Planning Guide, associated test plans, and safety planning. A list of attendance is attached (Attachment 1). The changes to safety planning incorporated the applicable amendments from th previous TPS flying qualities phase of instruction safety planning (Contr number 90-60) in addition to updating the planning to include the current

aircraft used (A-37, F-15, F-16, C-23, C-141, T-38) along with several new tasks (aerial refuel tracking, model identification, and photo/safety chase). The test plans specifically reviewed were the F-15B Flying Qualities Limited Test Plan (Air Superiority Fighter), T-38A Flying Qualities Limited Test Plan (Advanced Trainer), F-16B Flying Qualities Limited Test Plan (Ground Attack Fighter), and C-141A Flying Qualities Limited Test Plan (Strategic/Tactical Transport). Several actions items were generated. They are included in this section along with the projects responses.

2. References:
   a. Form 5028 USAFTPS Flying Qualities Phase, Oct 1990
   b. USAFTPS Flying Qualities Phase Planning Guide, Mar 1993
   c. T-38A Flying Qualities Limited Test Plan, Apr 1993
   d. F-15B Flying Qualities Limited Test Plan, Oct 1993
   e. F-16B Flying Qualities Limited Test Plan, Oct 1993
   f. C-141A Flying Qualities Limited Test Plan, Oct 1993

3. Mishap Responsibilities:
The curriculum aircraft, A-37, C-23, C-141, F-15, F-16, and T-38 are possessed by the AFFTC. AFFTC has mishap investigation and reporting responsibility. AFMC has mishap accountability for these aircraft.

Calspan VSS Learjet-24 and gliders are operated under civilian contract, therefore; the contractor has mishap accountability. Mishap investigation and reporting are the responsibility of the Federal Aviation Administration and National Transportation and Safety Board. Air Force involvement in mishap investigation and reporting is governed by AFR 127-1.

4. General Minimizing Considerations:

   a. General minimizing considerations for all curriculum sorties:

      (1) All Flying Qualities Phase syllabus flights will be conducted in accordance with the applicable aircraft's flight manual (with the exception of the A-37 spin sortie and F-16 departure sortie), AFFTCR 55-2, USAFTPS 51 series regulations/operating instructions and applicable aircraft guides.

      (2) Changes to the Flying Qualities Phase Planning Guide or to the Flying Qualities Test Plans require approval of the TPS Commandant. The TPS Commandant will determine which changes warrant coordination/approval from AFFTC/SET. Major changes to the Phase Planning Guide or the Test Plans will be via AFFTC Form 5028.

      (3) All Flying Qualities Phase syllabus flights will be conducted under the direct supervision of a TPS instructor. Students may only practice FTT that they have been demonstrated on the appropriate demonstration sortie.

      (4) All TPS IPs will receive initial FTT checkout training in flying qualities testing and receive the applicable FTT briefing (every 6 months) prior to instructing students.

(5) All Flying Qualities Phase syllabus flights will be flown in day VMC conditions.

(6) Except for demonstration points, engine(s) will not be shut down in flight except during actual emergencies which require such action.

(7) Except for ~~A-37~~ T-2 negative G spins and the F-16 inverted departure, negative G testing will not be accomplished and positive G testing will be limited to 6 G's or the Flight Manual limit, whichever is less.

(8) Test Plan Testing will not be accomplished below 5,000 ft AGL except for flight path stability testing and approved operational handling maneuvers. This limitation is not intended to preclude evaluation of the aircraft during takeoff, landing, approach or go-around phases of flight. The aircraft will be evaluated during these phases of flight insofar as possible using procedures outlined in Section II of the Flight Manual. Hand held force gauges will not be used below 5,000 ft AGL.

(9) For missions involving air-to-air or air-to-ground events, the applicable portions of the air-to-air or air-to-ground rules of engagement (ROE) covered in AFFTCR 55-2 and AFMCR 55-7 will be briefed before each mission. USAFTPS Operations Division will ensure each school briefing room maintains current copies of the ROE.

(10) Phase ~~E~~ B,C,D stalls and spins will be accomplished in a designated spin area. (for T-2s)

(11) Testing will be terminated and the appropriate flight manual recovery initiated when any indication of unintentional departure from controlled flight occurs.

b. ~~A-37~~ T-2 Minimizing Procedures: See Change 4

(1) For lateral-directional stability demo IP briefs spin ~~recovery and~~ engine roll back ~~procedures. No abrupt~~ aileron roll with tip fuel ~~at airspeeds~~ above 280 KIAS.

c. C-141 Minimizing Procedures:

(1) Speeds will be limited to a maximum of 95% of the flight manual airspeed/Mach limits. The minimum airspeed with an IP on board will be actual or computed stick shaker speed, whichever is greater.

(2) All simulated engine failure syllabus flights will be conducted in accordance with the flight manual, AFMCM 51-141, and AFR 60-16/AFMC Sup 1.

(3) Simulated engine failure (by throttle chop) on takeoff must be accomplished after airborne with a positive climb indication.

(4) All engine failures will be simulated by setting idle thrust with the exception of V_{mca} determination.

(5) Pilot reaction time will be simulated by no more than a three-second delay for engine-out sorties.

(6) The following restrictions apply to simulated two-engine approaches and landings:
   (a) Two engine go-arounds will not be performed.
   (b) Maximum weight for two engine approaches and landings is 220,000 lbs.
   (c) Maximum crosswind component is 15 knots.

(7) Normal load factor will be limited to 90% of the flight manual G limits.

(8) The flight engineers receive initial checkout training from an TPS IP on all FTT's to be flown in the C-141.

(9) Both Stall Prevention Systems must be operable for stall investigation and engine-out testing.

(10) Sideslips will be limited to 5 degrees with cargo doors open. For a non-instrumented aircraft this equates to approximately 1/4 pedal deflection.

(11) When the students are flying crew solo the following procedures apply:
   (a) Maximum crosswind for takeoff and landing is 10 knots (touch-and-go) or 15 knots (full stop) when the students are flying crew solo.
   (b) Minimum airspeed is 1.15 V_{stall}.
   (c) The scanner (2nd flight engineer) will be in the jump seat during critical phases of flight(i.e. takeoff and landing).
   (d) The minimum landing fuel is 25,000 pounds to allow for additional holding fuel in case of emergency.
   (e) Only primary test crewmembers will be on-board.
   (f) Minimum crew requirements are 2 pilots and 2 flight engineers.

d. F-15 Minimizing Procedures:

(1) Abrupt lateral stick deflections are prohibited above 475 knots below 12,000 feet.

(2) Afterburner initiation will be restricted to region 1 of the after-burner operating envelope.

e. F-16 Minimizing Procedures:

(1) The following procedures apply for the Departure Program.
   (a) All aircraft used for any departure sortie will have current weight and balance data and current fuel burn curves to control C.G. location. The target C.Gs. will be 38% for small horizontal tail aircraft and 41% for large horizontal tail aircraft.
   (b) The instructor training program will be accomplished in a build-up fashion starting with a clean configuration followed

by the centerline tank configuration. All sorties will be flown in F-16B's with a Hi AOA departure instructor.

(c) Phase II maneuvers will be performed with the throttle at IDLE and Starting Fuel Switch in LEAN.

(d) All departure sorties will be accomplished in an approved spin area at or above 35,000 ft MSL within gliding distance of suitable runway

(e) Flight tests have shown no unrecoverable mode with symmetrical loadings.

(f) Flights will be flown in day VMC with a discernible horizon.

(g) All ground training will be performed prior to any flight training being accomplished.

(h) No extraneous items (i.e. cameras, stopwatches, tape recorders, etc.) will be carried to reduce the probability of FOD.

(i) Deep Stall training in Block 10 aircraft will not be accomplished with the modified yaw rate limiter (TCTO 1880).

Delete ch.5 ~~(j) MPO assisted entries will not be performed in Block 15 aircraft with the modified yaw rate limiter (TCTO 1880~~).

(2) The limiter investigation will be flown above 15,000 feet AGL.

(3) Afterburner initiation will restricted to region 1 of the afterburner operating envelope.

f. T-38 Minimizing Procedures:

(1) Stall testing will be terminated and recovery will be complete by 10,000 ft AGL.

(2) Engines will not be reduced below 80% RPM during stall testing.

(3) No emergency patterns will be flown for evaluation at normal traffic pattern altitude. Failure states may be evaluated at altitude consistent with test restrictions.

(4) All testing will avoid the shaded engine compressor stall/flameout susceptibility areas found in Figure 7-1 of the T-38 Dash 1.

(5) Steady sideslips are limited to 20 degrees of bank in the power approach configuration.

(6) Testing will be terminated and the appropriate recovery initiated when any indication of imminent departure from controlled flight occurs.

g. Gliders

(1) Limitations in FAR (Part 61 and 91) and contractor local operating procedures will be followed.

(2) Minimum altitude for stall recovery is 1500' AGL.

(3) Maximum speed with tail weights installed is 108 KIAS

(4) No aerobatics or inverted entries to spins are allowed with tail weights installed.

(5) Parachutes will be worn on all spin sorties.

(6) No cassette recorders will be carried in the aircraft during spin sorties.

h. VSS Learjet-24

(1) Learjet flights will be flown within the constraints of Calspan Flight Manual Supplement, Calspan Flight Syllabus, and background material for USAF/USN TPS.

(2) Calspan will analyze and identify any Flight Controls Systems Project design configurations that may cause problems in the Learjet.

(3) Prior to student flights, an evaluation flight with a TPS staff IP will be performed to verify the controllability and safety of each design configuration.

5. TEST ARTICLE RESTRICTIONS: In accordance with the Flying Qualities Phase Planning Guide, Test Plans and OI's.

6. SPECIAL CONSIDERATIONS: None

ACTION ITEMS: In addition to the correction of several GMC's and additions to other paragraphs the following action item were generated:

1) Determine if the staff training package for high alpha training/ upgrades has all the associated test unique hazards for F-16 high alpha. *Note this was generated because there were several THA's that would not apply to student sorties or IP demos, but would for the high alpha IP checkout.*

Ans: Associated test unique hazards for F-16 high alpha are not currently included in the staff training package. They will be incorporated into the package at the next safety review of the staff training package. In the interim, the THAs in question will continue to be included in this package.

2) Delineate the exceptions from flight manual operations (TPS waivers etc.) and state them as such in the GMC section.

Ans: The GMC section now states that all Flying Qualities Phase syllabus flights will be conducted in accordance with the applicable aircraft's flight manual with the exception of the A-37 spin sortie and the F-16 Departure sortie.

3) Determine what constitutes minimum crew for the C-23.

Ans: Minimum crew for the C-23 is 2 pilots.

4) Determine if the C-23 rudder locks (the response may generate some additional limits during the LAT-DIR investigations).

Ans: No, the C-23 does not rudder lock.

5) Add touch down criteria (how far down the runway) for the offset landing task. *This action item was generated due to concern of no build-up in stick input or build-down in altitude for the task.*

Ans: The next printing of the Flying Qualities Phase Planning Guide will include touchdown criteria for the offset landing task. This criteria will redefine the touch down point no closer than 1000 feet from end of runway.

6) Three engine takeoffs (C-141) should have a limitation concerning the computed climb gradient. Determine a limitation for minimum climb gradient three engine (one engine at idle) and a climb gradient in the event of a real loss of the next most critical engine (two engine climb).

Ans: All simulated engine failure syllabus flights are conducted in accordance with the flight manual, AFMCM 51-141, and AFR 60-16/AFMC Sup 1. Aircraft weight for simulated engine failure sorties will always allow obstacle clearance on three engines IAW the flight manual. Simulated engine failures will not be initiated on climbout until the aircraft has achieved a positive rate of climb on all engines IAW AFR 60-16/AFMC Sup 1.

7) Clarify the two engine out landing (C-141 p. 3.5.7).
   a) Do you plan on a two engine go-around (is it possible)?
   b) Are two engine approaches routinely practice in the field?
   c) Are there any special training/currency requirements for two engine approaches?

Ans: All simulated engine failure syllabus flights are conducted in accordance with the flight manual, AFMCM 51-141, and AFR 60-16/AFMC Sup 1. Two engine go-arounds are not permitted by AFR 60-16/SFMC Sup 1. Simulated two engine out approach and landings at normal traffic pattern altitudes are permitted by AFMCM 51-141 with DFO approval. TPS has approval to do simulated two engine out approach and landings at normal traffic pattern altitudes with some additional restrictions. These additional restrictions have been included in the GMCs.

8) The straight ahead push-over maneuver (p 5.12) is not clear enough. It should emphasize that it is not a negative g maneuver and an associated caution of the lift vector being reversed in the event of negative g's added. This occur in several other places also, that need to be corrected (p 5.16, 5.21, 5.30) *It was suggested that the maneuver describe a 1/2 g push with the associated caution.*

Ans: The next printing of the Flying Qualities Phase Planning Guide will include additional guidance on the straight ahead push-over maneuver. This guidance will include a note that this is not

intended to be a negative G maneuver and that the lift vector is reversed under negative G flight.

9) The pop-up patterns do not appeared to be demonstrated by an IP before being required by student test plans. Make sure that the associated FTT is demonstrated by an IP before being required by students.

Ans: The pop-up patterns will be added to the operational handling demo FTT in the next printing of the Flying Qualities Phase Planning Guide.

10) It was not clear as to the F-16 rudder doublet limit at 300 KTAS/ 0.6 M. Investigate the limit and ensure the test plans and FTT's do not exceed the intent of the restriction.

Ans: In a telephone conversation with a Lockheed engineer is was determined that the test plans and FTT's do not exceed the intent of the restriction. The restriction is intended to prevent rapid rudder reversals with high sideslip angles. The rudder doublets that are part of the Flying Qualities phase are for model identification, where sideslip angles are two degrees or less.

6. <u>RISK ASSESSMENT</u>: Low

7. <u>COORDINATION COMMENTS</u>:
Recommend adding the following minimizing procedure to THA #1 Midair Collision, "8. TPS missions will be flown outside R2515 to the maximum extent possible." Maj Robert Wilson, Fighter Representative.

Response: When possible TPS missions are flown outside of R2515. Therefore, adding this minimizing procedure would have minimal impact on safety and could possibly impose undue restrictions on TPS missions.

TES· IAZARD ANALYSIS (THA)	PAGE 1 OF 9 PAGES
TEST SERIES USAF TPS Flying Qualities Phase	HAZARD CAT/PROBABILITY I/Remote
PREPARED BY (TYPE NAME AND TITLE) Daniel D. Llewelyn, Captain	SIGNATURE Daniel D. Llewelyn
UNIT TEST SAFETY OFFICER (TYPE NAME AND GRADE) James A. Esch, Captain	SIGNATURE James A. Esch

HAZARD: Midair Collision

CAUSE: Lack of clearing due to data fixation causing excessive "heads down" time

EFFECT: Damage/Loss of Aircraft and Crew

MINIMIZING PROCEDURES:

1. Midair collision avoidance will be briefed prior to each sortie.
2. Students will receive midair hazard brief as part of their local orientation.
3. TPS will use Sport/RAPCON active monitoring on all sorties.
4. Crews will terminate all test maneuvers when traffic is called within 3 miles laterally and ±5,000 feet horizontally.
5. "Heads down" time will be minimized, i.e., data will be taken by rear cockpit member.
6. Chase aircraft (when available) will provide additional clearing for the flight.
7. Specific ROE will be briefed during the air-to-air operational handling flight briefing.

CORRECTIVE ACTION: In the event of a midair collision, Flight Manual and local procedures (e.g. controlled jettison, if necessary) will be followe

TEST HAZARD ANALYSIS (THA)	PAGE 2 OF 9 PAGES
TEST SERIES USAF TPS Flying Qualities Phase	HAZARD CAT/PROBABILITY I/Remote
PREPARED BY (TYPE NAME AND TITLE) Daniel D. Llewelyn, Captain	SIGNATURE Daniel D. Llewelyn
TEST SAFETY OFFICER (TYPE NAME AND GRADE) James A. Esch, Captain	SIGNATURE James A. Esch

HAZARD: Unintentional Loss of Control, Departure or Spin During Stall and V_{mca} Tests.

CAUSE: Improper Pilot Procedures

EFFECT: Loss of Aircrew and/or Aircraft.

MINIMIZING PROCEDURES:
General
All pilots receive instruction during the Glider Spin Demo, A-37 Stall/Spin Demo, and stall training (CF rides) in their data aircraft prior to stall data flights.

~~A-37~~ T-2 (See Change 4)
1. All A-37 stall FTTs are conducted with an instructor on board.
2. Stall FTTs conducted > 20,000 ft MSL.
3. Recovery completed by 10,000 ft AGL.
4. Stalls initiated with 70 lbs maximum fuel imbalance.
5. Recovery initiated at G break, indication of departure, aft stick stop reached with no increase in AOA, or sustained or intolerable buffet.
6. Tail slides and vertical stalls will not be performed.

T-38
1. Stall testing will be terminated and recovery will be completed by 10,000 ft AGL.

C-141
1. All multi-engine demonstration flights will be conducted with a current qualified IP on board. To perform stalls and V_{mca} testing, the IP must be a TPS graduate, and must be at the controls.
2. Stalls will only be performed IAW the current aircraft Dash 1 and other aircraft specific directives and regulations.

CORRECTIVE ACTION: If unintentional loss of control, departure, or spin occurs during stall or V_{mca} tests, the flight manual recovery will be initiated.

TEST HAZARD ANALYSIS (THA)

TEST SERIES USAF TPS Flying Qualities Phase	HAZARD CAT/PROBABILITY II/Remote
PREPARED BY (TYPE NAME AND TITLE) Daniel D. Llewelyn, Captain	SIGNATURE Daniel D. Llewelyn
UNIT TEST SAFETY OFFICER (TYPE NAME AND GRADE) James A. Esch, Captain	SIGNATURE James A. Esch

HAZARD: Engine Instability, Stall, Flameout or Over Temp Condition During Intentional Stalls, Departures, or Spins

CAUSE:
1. Engine Malfunction
2. Improper Throttle Techniques
3. Incorrect RPM Setting
4. Inlet flow distortion

EFFECT: Damage to Engine(s), Major aircraft damage

MINIMIZING PROCEDURES:

~~A-37~~ T-2 (See Change 4)
1. (2) Engine RPM will be 65% minimum for stalls and 65% to 70% for planned spin entries.
2. (1,2) IP will monitor engines during spins.
3. (1,2,3) Igniters will be placed to EMER ON for all inverted spins.
4. (1) A negative G/FOD engine operation check will be performed prior to spins. RPM during the FOD check will be 85% or less.

T-38
1. (2) Engines will not be reduced below 80% RPM during stall testing.

F-16
1. (2,4) All intentional departures will be performed with the throttle position in IDLE to provide greater stall margin.
2. (4) Airstart checks will be accomplished prior to departure sorties.
3. (1) For departure sorties the Starting Fuel Switch will be placed in the LEAN position to reduce the potential for a hot start.

CORRECTIVE ACTION:

~~A-37~~ T-2 (See Change 4)
1. If the EGT approaches 900 deg C during the spin the IP will call for engine shutdown.
2. The occurrence of a dual engine flameout during the mission will be cause for mission termination.
3. All engine shutdowns and restarts will be IAW the flight manual.

T-38
1. All engines anomalies will be handled IAW the flight manual.

F-16
1. In the event of stagnation, an aerodynamic recovery will be immediately attempted, and following return to controlled flight the engine anomaly will be addressed per Flight Manual procedures.
2. In the event of a self recovering stall, the throttle will be set to 80% and the EEC will be cycled to OFF, then EEC.
3. In the event of an unsuccessful airstart attempt, the pilot will continue to attempt a restart by increasing airspeed and reinitiating the start sequence. Below 20,000 feet MSL, the JFS may be used as an alternate means of motoring the engine.
4. Attempts to airstart the engine will terminate at 12,000 feet MSL.

TEST HAZARD ANALYSIS (THA)	PAGE 4 OF 9 PAGES
TEST SERIES USAF TPS Flying Qualities Phase	HAZARD CAT/PROBABILITY I/Improbable
PREPARED BY (TYPE NAME AND TITLE) Daniel D. Llewelyn, Captain	SIGNATURE Daniel D. Llewelyn
TEST SAFETY OFFICER (TYPE NAME AND GRADE) James A. Esch, Captain	SIGNATURE James A. Esch

Replaced (See Change 1)

HAZARD: Aircraft Failure to recover from Intentional Departure or Spin.

CAUSE: Improper Pilot Procedure

EFFECT: Loss of Aircrew and/or Aircraft.

MINIMIZING PROCEDURES:

General

All spin training is conducted only with a qualified instructor on board; any particular student spin project involving solo flight (i.e., systems project) will complete a separate safety review. Cassette recorders will not be used on spin/departure flights.

ASK-21

1. Minimum altitude for spin entry is 2,500 ft AGL, flight manual recovery will be initiated not later than 2,000 ft AGL.
2. Recoveries other than the flight manual will not be held longer than two turns.
3. Only 1 G entries and upright spins are allowed.

A-37

1. The pre-spin checklist will be accomplished prior to each spin.
2. No more than 70 lbs fuel imbalance between wings shall exist for spin entry.
3. Only stalls and spins currently approved as published in the Flying Qualities Phase Planning Guide will be flown.
4. A recovery technique other than the flight manual will be held no more than 3 turns.
5. To minimize crew distractions, the A-37 will have UHF guard turned off and the gear aural warning circuit breaker pulled.
6. If the aircraft does not recover after three turns of a non-standard recovery or if the A-37 descends below 18,000 ft MSL, the flight manual recovery will be initiated.
7. Tip tanks will be empty prior to the first spin.

CORRECTIVE ACTION:

ASK-21

1. Parachutes will be worn.
2. Jettison canopy and bailout at 1500 ft AGL.

A-37

1. The canopy will be jettisoned at 15,000 ft MSL if not recovered.
2. Ejection will be at 12,000 ft MSL if not recovered from the spin.

Remarks:

1. One backup source for altitude calls is desired for student training missions. Chase, SPORT or Cobra TM will call "18,000 ft", "15,000 ft", and "12,000 ft" when the A-37 passes that altitude.
2. Parachutes will be worn on glider spin rides.

TES IAZARD ANALYSIS (THA)	PAGE 5 OF 9 PAGES
TEST SERIES USAF TPS Flying Qualities Phase	HAZARD CAT/PROBABILITY II/Remote
PREPARED BY (TYPE NAME AND TITLE) Daniel D. Llewelyn, Captain	SIGNATURE Daniel D. Llewelyn
UNIT TEST SAFETY OFFICER (TYPE NAME AND GRADE) James A. Esch, Captain	SIGNATURE James A. Esch

HAZARD: Boom Contacts Test Aircraft During Boom Tracking Task (C-141A)

CAUSE: Improper Pilot Procedure

EFFECT: Minor Aircraft Damage

MINIMIZING PROCEDURES:

1. Boom operator will be briefed by test aircraft IP concerning test maneuvers and termination procedures.
2. Test aircraft will stabilize no closer than 50 feet aft of tanker to practice formation procedures before beginning task. If the student is having difficulty flying 50 feet aft of the boom, no attempt will be made to close into the 10 foot limit.
3. Test aircraft IP or boom operator will make "terminate" radio call if potential unsafe situation is developing.
4. If test aircraft approaches within 10 feet of boom, the boomer will call "Break Away" and the task will be discontinued . Standard Flight Manual break away procedures used with the C-141B will be used.
5. Tailored checklist will be used that has been adapted from C-141B air refueling (AR) procedures.
6. All maneuvers will be flown within the envelope of the tanker boom.
7. No greater than light turbulence will be allowed during task.

CORRECTIVE ACTION: Damaged aircraft will follow flight manual procedures for RTB. The other aircraft, or chase aircraft, if available, will be used to inspect damage.

REMARKS:

1. No AR will be performed. The C-141A does not have an AR receptacle; however the C-141B has an established and known AR envelope with no adverse flying qualities.
2. TPS IPs have previously evaluated task.
3. Test aircraft IPs are previously C-141B AR qualified and training for the boom tracking task is done in accordance with USAFTPS OI 51-14.

TEST HAZARD ANALYSIS (THA)

TEST SERIES USAF TPS Flying Qualities Phase	HAZARD CAT/PROBABILITY I/Improbable
PREPARED BY (TYPE NAME AND TITLE) Daniel D. Llewelyn, Captain	SIGNATURE Daniel D. Llewelyn
TEST SAFETY OFFICER (TYPE NAME AND GRADE) James A. Esch, Captain	SIGNATURE James A. Esch

HAZARD: Aircraft out of control at 13,000 feet MSL (F-16 Departure Sortie)

CAUSE:
1. Post stall aerodynamics recovery procedure ineffective.
2. CG further aft than desired.
3. All recovery procedures ineffective.

EFFECT: Loss of aircraft/death

MINIMIZING PROCEDURES:
1. (1) Flight test proven flight manual recovery procedures are employed by the pilot and monitored by the instructor pilot in the rear cockpit. The recovery procedures are included in each preflight brief.
2. (3) The instructor pilot is the primary safety observer.
3. (2) Fuel quantity and switchology will be verified prior to each pass in the spin area.
4. (2) The pilot will ensure the centerline fuel tank is empty prior to performing any deep stall maneuvers.
5. (2) Prior to conducting departure training, current aircraft weight and balance data, including fuel burn curves, will be provided.

CORRECTIVE ACTIONS:
1. If aircraft control is lost and a positive indication of aerodynamic recovery is not apparent, or if the aircraft exhibits an unexpected response, the IP will take aircraft control of the aircraft not later than 28,000 feet MSL. In the event the aircraft remains in a deep stall, MPO pitch rocking will continue. In addition to continuing the MPO pitch rocking the instructor may use the following techniques: 1) speed brakes, and if erect the following: 2) aft feed, 3) alternate flaps, 4) MAX afterburner and stores jettison.
2. If SPORT or chase are available, they will backup the IP with appropriate altitude calls.
3. If a positive indication of recovery is not apparent at 13,000 feet MSL, the crew will eject.

TES HAZARD ANALYSIS (THA)

TEST SERIES USAF TPS Flying Qualities Phase	HAZARD CAT/PROBABILITY I/Remote
PREPARED BY (TYPE NAME AND TITLE) Daniel D. Llewelyn, Captain	SIGNATURE Daniel D. Llewelyn
UNIT TEST SAFETY OFFICER (TYPE NAME AND GRADE) James A. Esch, Captain	SIGNATURE James A. Esch

HAZARD: F-16 Unsuccessful Airstart Attempt.

CAUSE: 1. Mechanical or electrical malfunction.
2. Aircraft outside of airstart envelope.

EFFECT: Loss of aircraft/crew.

MINIMIZING PROCEDURES:

1. (2) Prior to the airstart familiarization sortie, the upgrading pilot will receive thorough ground training and a detailed preflight briefing. The preflight briefing will emphasize the following:
   a. Engine temperature and RPM limits.
   b. Limits for airstart capability.
   c. Engine-out glide capability/flameout procedures.
   d. Engine emergency procedures.
2. (2) The selected airstart familiarization points are well within the operational limits of the F-16, and have shown a 100 percent success rate for previous airstart training.
3. (2) Critical engine parameters will be monitored by a qualified instructor pilot.
4. (1) A BUC ground start will be accomplished for airstart familiarization missions.
5. (1) The JFS will be tested for a minimum of one minute prior to engine shutdown for airstart sorties, and will be allowed to cool for a minimum of 5 minutes between airstarts.
6. (1) For departure sorties the Starting Fuel Switch will be placed in the LEAN position to reduce the potential for a hot start.

CORRECTIVE ACTION:

1. In the event of an unsuccessful airstart attempt, the pilot will continue to attempt a restart by increasing airspeed and reinitiating the start sequence. Below 20,000 feet MSL, the JFS may be used as an alternate means of motoring the engine.

2. Attempts to airstart the engine will terminate at 12,000 MSL.

REMARKS: This THA does not apply to student sorties or IP demos. It applies only to F-16 high alpha IP checkout.

TEST SERIES USAF TPS Flying Qualities Phase	HAZARD CAT/PROBABILITY I/Remote
PREPARED BY (TYPE NAME AND TITLE) Daniel D. Llewelyn, Captain	SIGNATURE Daniel D. Llewelyn
T SAFETY OFFICER (TYPE NAME AND GRADE) J... A. Esch, Captain	SIGNATURE James A. Esch

HAZARD: F-16 Unsuccessful Flameout Landing.

CAUSE:
1. Not within gliding distance of a suitable runway.
2. Vision restricted by canopy fogging or weather.
3. Pilot error.
4. Insufficient EPU fuel.
5. Other aircraft conflicts during FO pattern.

EFFECT: Loss of aircraft/crew

MINIMIZING PROCEDURES:
1. (3) The crew will review flight manual flameout landing procedures during the preflight briefing.
2. (5) Tower will monitor the mission frequency on airstart familiarization missions, and will be contacted prior to engine shutdown.
3. (3) For the airstart familiarization sortie pilots will be SFO current, and a practice SFO will be flown to the primary flameout runway (touch and go on the main runway; low approach to a lakebed).
4. (1) Airstarts will be accomplished within gliding distance of high key (normally in the vicinity of a spin area). A dry lakebed runway is preferred, with the hard surface runway as a backup.
5. (4) Minimum hydrazine levels, prior to an engine shutdown are:

ALTITUDE	EPU FUEL QTY REQUIRED
30,000 FT	70%
25,000 FT	60%
20,000 FT	50%

6. (2) Prior to shutdown the canopy defog will be run for a minimum of 1 minute to minimize canopy fogging.
7. (2) Weather must permit descent to high key and landing in VMC. The crew must also have the Edwards landing environment in sight before engine shutdown.
8. (3) Airstart attempts will terminate 2,000 feet above high key altitude and pilots will concentrate on executing the flameout landing.
9. (4) For the airstart familiarization sortie the EPU will be checked prior to the first airstart.

CORRECTIVE ACTION: None

REMARKS: This THA does not apply to student sorties or IP demos. It applies only to F-16 high alpha IP checkout.

TES HAZARD ANALYSIS (THA)

HAZARD CAT/PROBABILITY
III/Remote

TEST SERIES
USAF TPS Flying Qualities Phase

PREPARED BY (TYPE NAME AND TITLE)
Daniel D. Llewelyn, Captain

SIGNATURE
Daniel D. Llewelyn

UNIT TEST SAFETY OFFICER (TYPE NAME AND GRADE)
James A. Esch, Captain

SIGNATURE
James A. Esch

HAZARD: F-16 Loss of Cabin Pressurization.

CAUSE: Environmental Control System (ECS) cutback, shutdown, or malfunction which eliminates ECS air flow to the cockpit.

EFFECT: Injury to aircrew (Physiological Incident).

MINIMIZING PROCEDURES:

1. Pilots will pre-breathe 100% oxygen uninterrupted for 30 minutes prior to the first airstart.
2. Exposures to cabin altitudes above 25,000 feet but less than 35,000 feet will be limited to less than ten minutes total in a 24 hour period.
3. Pilots will monitor the cabin pressure altitude gauge in the cockpit, and the length of exposure time will be considered to be the length of time from shutdown to IDLE power.
4. It is not the intent of the above minimizing procedures to violate the direction of AFR 60-16 which states: "If the aircraft loses cabin pressure, the pilot must initiate an immediate descent to the lowest practical altitude but in no case must the pilot maintain the cabin altitude above 25,000 feet, unless the occupants are wearing functional pressure suits.: (60-16, 6-4c(1))

CORRECTIVE ACTION: If cabin pressure altitude begins to exceed 25,000 ft, a descent will be made to maintain a cabin pressure altitude below 25,000 ft.

REMARKS:

1. During low engine RPM turnaround airstarts there is the possibility of very short duration exposures to cabin pressures above 25,000 feet."
2. This THA does not apply to student sorties or IP demos. It applies only to F-16 high alpha IP checkout.

AFFTC FORM 5028A APR 93 (EF PREVIOUS EDITION IS OBSOLETE

TEST PROJECT SAFETY REVIEW (INITIAL AND AMENDMENT)

(Refer to AFFTCR 127-3 for complete instructions)

I. PROJECT INFORMATION

INITIAL PROJECT TEST TITLE	INITIAL RISK LEVEL	CONTROL NUMBER	TEST AGENCY
Test Pilot School Flying Qualities Phase	LOW	94-31	USAF TPS
SUBJECT OF AMENDMENT	**AMENDMENT ~~RISK LEVEL~~**	**CHANGE NUMBER**	**PROJECT JON**
Update to A-37 Spin Training	LOW	1	M94C1400

PROJECT MANAGER (Typed Name and Grade)	SIGNATURE	PHONE NUMBER	DATE
Alan J. Borton, Maj	Alan J Borton	7-2348	14 Nov 94
UNIT TSO (Typed Name and Grade)	**SIGNATURE**	**PHONE NUMBER**	**DATE**
James A. Esch, Maj	James A. Esch	7-8038	14 Nov 94

II. SAFETY REVIEW MEMBERS

	NAME, GRADE, AND TITLE	SIGNATURE AND DATE		NAME, GRADE, AND TITLE	SIGNATURE AND DATE
a.	Robert Wilson, Maj. Operations Rep	Robert A Wilson	f.		
b.	James Ford, Civ Mechanical Systems	James A. Ford	g.		
c.			h.		
d.			i.		
e.			j.		

III. COORDINATION AND APPROVAL

POSITION TITLE	SIGNATURE	DATE	ACTION (COORD, APPROVE, INFO, OR N/A)	COMMENTS ADDED YES	COMMENTS ADDED NO
TEST SAFETY OFFICER AFFTC/SET	David A [illegible]	17 Nov 94	Coord	✓	
DIRECTOR OF SAFETY AFFTC/SE	[illegible]	18 Nov 94	Coord	✓	
SQUADRON COMMANDER OR EQUIVALENT USAF TPS/DO	[illegible] M. [illegible]	18 Nov 94	Coord	✓	
TEST WING ENGINEERING OR EQUIVALENT 412 TW/TS	[illegible] 18 Nov 94	18 NOV 94	Coord		✓
GROUP COMMANDER OR EQUIVALENT USAF TPS/CC	[illegible]	18 NOV 94	Approve	✓	
GROUP COMMANDER OR EQUIVALENT N/A			N/A		
TEST WING COMMANDER OR EQUIVALENT 412 TW/CC	Ted McFarland	5 Dec 94	Info		✓
COMMANDER (OR AS DELEGATED) AFFTC/CC	[illegible]	12 Dec 94	Info		✓

RETURN TO AFFTC/SET

IV	PROJECT DESCRIPTION
INSTRUCTIONS: Include the following sections: Background, Test Objectives, Test Item Description, System Maturity, Types of Tests, Differences from Previous Tests and Scope. An amendment will incorporate changes inherent within these sections. Use additional sheets if necessary,	

V.	SAFETY REVIEW SUMMARY
INSTRUCTIONS: Include the following sections: Review Synopsis, References, Mishap Responsibilities, General Minimizing Considerations, Special Considerations, Action Items, Risk Assessment, and Coordination Comments. An amendment will incorporate changes inherent within these sections. Use additional sheets if necessary.	

SECTION IV: PROJECT DESCRIPTION

1. BACKGROUND: In August 1994, an A-37B crashed during a USAF Test Pilot School (TPS) spin mission. The probable cause of the mishap was a lateral fuel imbalance which with the proper conditions , led to an unrecoverable spin mode. Since then, various methods have been investigated for eliminating the potential of a lateral fuel imbalance. The most promising method involves two modifications to the present procedures: 1) no fuel in the tip tanks for spin sorties, and 2) safety wiring the tip tank dump valves in the open (dump) position. Though this method limits the sortie length due to less on-board fuel, it virtually eliminates the possibility of a fuel imbalance inflight. Any fuel forced out from internal tanks to the tips due to centrifugal force during a spin will be automatically vented overboard. Flight test data indicate that 20-30 pounds of fuel per tip tank per spin could be forced out to the tips.

2. DESCRIPTION OF CHANGE: This proposed method will be incorporated into the minimizing procedures for the A-37. It will not change the guidance given in the Flying Qualities Phase Planning Guide. However, due to the limited on-board fuel, the full spin profile may not be completed.

SECTION V: SAFETY REVIEW SUMMARY

1. SYNOPSIS:

Technical - No changes are planned to the test objectives of the phase planning guide. This amendment does not change the technical content of the spin missions. It does however impart the schools ability to accomplish all of the desired spin training. No TRB required.

Safety - This amendment is within scope of the original safety planning. A reconvene was not required, however a review by a non-project operational representitive was required. Test Pilot School engineering accomplish a thorough review of the engineering issues associated with leaving the dump valves open. They've accomplished adequate system safety analysis and no issues remain open from the analysis.

2. CHANGES TO SAFETY PLANNING:
   a. Include the following to general minimizing procedures for the A-37 (AFFTC Form 5028, Section 4b): ~~Prior to spin flights, tip tanks will be visually verified empty and the tip tank dump valves will be safety wired to the open (dump) position. Additionally, pilots will check for empty tip tanks prior to each spin by positioning the tip tank switches to ON and noting the "L TIP EMPTY" and "R TIP EMPTY" annunciator lights illuminated.~~ (Replaced - See Change 2)
   b. The attached THA replaces the THA of the same subject (Aircraft Failure to Recover from Intentional Departure or Spin) in the original safety planning. The A-37 corrective action #1 is updated as follows:
      1. If not recovered by 15,000 ft MSL , the instructor will decide whether to:
         a. apply anti-spin ailerons,
         b. trim full aft to provide a slight increase in nose-down elevator authority for erect spins, or
         c. jettison the canopy in preparation for ejection.

3. SPECIAL CONSIDERATIONS: A curriculum development sortie shall be accomplished to evaluate the impact of this change and determine if additional planning is required.

4. RISK ASSESSMENT: This change does not alter the assigned risk of LOW for the spin mission. Recommend approval of the curriculum development sortie as LOW risk. Based on the results of the curriculum development sorties, the approval of the changes for student sorties should also be considered LOW risk.

5. COORDINATION COMMENTS:
With the dump valves wired open the potential for fuel contamination may be increased. Suggest "Remove before flight" covers for the valve openings. D. Lazer.

5. Coordination Comments (Cont'd)

AFFTC/SE

According to the THA, no backup support is required - only desired (i.e. chase, SPORT, or Cobra TM). Is the intent of TPS to fly these mission without any support? If so, will there be any additional restrictions? I'd like this issue to be reviewed by TPS and answered in coordination comments.

Jim Bower

LTC Jim Bower
Acting AFFTC/SE

Response to Coordination Comments

1. Maintenance is fabricating "Remove Before Flight" covers for the vent valve openings.

2. The THA wording has been changed to require one backup source for altitude calls. Chase, SPORT, or Cobra TM will call "18,000 ft", "15,000 ft", and "12,000 ft" when the A-37 passes that altitude.

5 COORD COMMENTS - CONT

PLS SPECIFY 'SENSE' OF ANTI-SPIN AILERON IN PARA 2 b1(a) CHANGE TO SAFETY PLANNING

J DOOLITTLE

TPS/DO Coord Comments

1) Remark 1 should state that a backup source of alt calls is req'd for all missions.

2) A-37 Corrective action: "by 15,000 ft MSL, the instructor should consider use of any ...."

Response:

All action items complied with.

JE

TE_ . HAZARD ANALYSIS (THA)

TEST SERIES USAF Test Pilot School Flying Qualities Phase	HAZARD CAT/PROBABILITY I/Improbable
PREPARED BY (TYPE NAME AND TITLE) Alan J. Borton, Maj	SIGNATURE Alan J Borton
UNIT TEST SAFETY OFFICER (TYPE NAME AND GRADE) James A. Esch, Maj	SIGNATURE James A. Esch

HAZARD: Aircraft Failure to recover from Intentional Departure or Spin.

CAUSE: Improper Pilot Procedure

EFFECT: Loss of Aircrew and/or Aircraft.

MINIMIZING PROCEDURES:
General: All spin training is conducted only with a qualified instructor on board; any particular student spin project involving solo flight (i.e., systems project) will complete a separate safety review. Cassette recorders will not be used on spin/departure flights.

ASK-21
1. Minimum altitude for spin entry is 2,500 ft AGL, flight manual recovery will be initiated not later than 2,000 ft AGL.
2. Recoveries other than the flight manual will not be held longer than two turns.
3. Only 1 G entries and upright spins are allowed.

~~A-37~~ T-2 (See Change 4)
1. The pre-spin checklist will be accomplished prior to each spin.
2. No more than 70 lbs fuel imbalance between wings shall exist for spin entry.
3. Only stalls and spins currently approved as published in the Flying Qualities Phase Planning Guide will be flown.
4. A recovery technique other than the flight manual will be held no more than 3 turns.
5. To minimize crew distractions, the A-37 will have UHF guard turned off and the gear aural warning circuit breaker pulled.
6. If the aircraft does not recover after three turns of a non-standard recovery or if the A-37 descends below 18,000 ft MSL, the flight manual recovery will be initiated.
7. Tip tanks will be empty prior to the first spin.

CORRECTIVE ACTION:
ASK-21
1. Parachutes will be worn.
2. Jettison canopy and bailout at 1500 ft AGL.

~~A-37~~ T-2 (See Change 4)
1. If not recovered by 15,000 ft MSL, the instructor should consider use of any combination of the following techniques:
   a. apply anti-spin ailerons - opposite spin direction (erect) or in direction of spin (inverted),
   b. trim full aft to provide a slight increase in nose-down elevator authority for erect spins,
   c. jettison the canopy in preparation for ejection.
2. Ejection will be at 12,000 ft MSL if not recovered from the spin.

Remarks:
1. One backup source for altitude calls is required for spin mission Chase, SPORT or Cobra TM will call "18,000 ft", "15,000 ft", and "12,000 f when the A-37 passes that altitude.
See Change 4
2. Parachutes will be worn on glider spin rides.

TEST PROJECT SAFETY REVIEW (INITIAL AND AMENDMENT)

(Refer to AFFTCR 127-3 for complete instructions)

I. PROJECT INFORMATION

INITIAL PROJECT TEST TITLE	INITIAL RISK LEVEL	CONTROL NUMBER	TEST AGENCY
Test Pilot School Flying Qualities Phase	LOW	94-31	USAF TPS
SUBJECT OF AMENDMENT	**~~AMENDMENT RISK LEVEL~~**	**CHANGE NUMBER**	**PROJECT JON**
A-37 Spin Training with modified tip tank float valves	LOW	2	M94C1400

PROJECT MANAGER (Typed Name and Grade)	SIGNATURE	PHONE NUMBER	DATE
Alan J. Borton, Maj	Alan J Borton	7-2348	21 Nov 94
UNIT TSO (Typed Name and Grade)	**SIGNATURE**	**PHONE NUMBER**	**DATE**
James A. Esch, Maj	James A. Esch	7-8038	21 Nov 94

II. SAFETY REVIEW MEMBERS

	NAME, GRADE, AND TITLE	SIGNATURE AND DATE		NAME, GRADE, AND TITLE	SIGNATURE AND DATE
a.	Robert Wilson, Maj Operations Rep	21 Nov 94	f.		
b.	James Ford, Civ Mechanical Systems		g.		
c.			h.		
d.			i.		
e.			j.		

III. COORDINATION AND APPROVAL

POSITION TITLE	SIGNATURE	DATE	ACTION (COORD, APPROVE, INFO, OR N/A)	COMMENTS ADDED YES	COMMENTS ADDED NO
TEST SAFETY OFFICER AFFTC/SET		22 Nov 94	Coord		✓
DIRECTOR OF SAFETY AFFTC/SE		22 Nov 94	Coord		✓
SQUADRON COMMANDER OR EQUIVALENT USAF TPS/DO		22 NOV 94	Coord		✓
TEST WING ENGINEERING OR EQUIVALENT 412 TW/TS		23 Nov 94	Coord		✓
GROUP COMMANDER OR EQUIVALENT USAF TPS/CC (for)		23 Nov 94	Approve		✓
GROUP COMMANDER OR EQUIVALENT 412 OG/CC		1 Dec 94	Info		✓
TEST WING COMMANDER OR EQUIVALENT 412 TW/CC		5 Dec 94	Info		✓
COMMANDER (OR AS DELEGATED) AFFTC/CC		12 Dec 94	Info		✓

RETURN TO AFFTC/SET

AFFTC FORM 5028 APR 93 (EF) Replaces AFFTC Forms 5028, Sep 89, and 5028b, Feb 91, which will not be used

PROJECT DESCRIPTION
IV
INSTRUCTIONS: Include the following sections: Background, Test Objectives, Test Item Description, System Maturity, Types of Tests, Differences from Previous Tests and Scope. An amendment will incorporate changes inherent within these sections. Use additional sheets if necessary,

SAFETY REVIEW SUMMARY
V.
INSTRUCTIONS: Include the following sections: Review Synopsis, References, Mishap Responsibilities, General Minimizing Considerations, Special Considerations, Action Items, Risk Assessment, and Coordination Comments. An amendment will incorporate changes inherent within these sections. Use additional sheets if necessary.

SECTION IV: PROJECT DESCRIPTION

1. BACKGROUND: In August 1994, an A-37B crashed during a USAF Test Pilot School (TPS) spin mission. The probable cause of the mishap was an excessive tip tank lateral fuel imbalance which resulted in an unrecoverable spin mode. Since tip tank fuel is not directly measured on the A-37 (other than tip tank empty lights), the accident board recommended instrumenting the tip tanks prior to resuming spin training. Many options were pursued by TPS until it was discovered the tip tank float switches (operationally used to measure tip tanks full during air refueling) could be repositioned to the bottom of the tip tanks and inverted for use to measure tip tanks empty. When tip tanks are empty, the float switch will activate and illuminate the respective tip tank light on the air refueling panel located on the windshield canopy bow if the air refueling switch is in the ON position.

2. DESCRIPTION OF CHANGE: The general minimizing procedures for the A-37 will be updated. This change does not affect the guidance currently given in the Flying Qualities Phase Planning Guide regarding conduct of spin missions. The tip tank float switch modification required a change to the A-37 Partial Flight Manual.

SECTION V: SAFETY REVIEW SUMMARY

1. SYNOPSIS:

Technical - No changes to the test objectives of the Flying Qualities Phase Planning Guide are planned. This amendment does not change the technical content of the spin missions. This modification has previously been thoroughly discussed at the Design Review Board. No TRB is required.

Safety - This amendment is within the scope of the original safety planning. A safety review board reconvene was not required, however, review by non-project operational and engineering representatives was required. Test Pilot School engineering and 412 TW/TSIDM accomplished a thorough review of the engineering issues associated with the tip tank float valve modification. Adequate system safety analysis has been accomplished and no issues remain open from the analysis.

2. CHANGES TO SAFETY PLANNING:

Include the following to the general minimizing procedures for A-37s with the tip tank float valve modification (AFFTC Form 5028, Section 4b):

a. During ground operations, check both tip tank lights illuminate on the air refueling panel by momentarily positioning the air refueling switch to the CHECK position.
b. Prior to spinning, position the air refueling panel switch to the ON position. The tip tank light(s) will illuminate when the corresponding tip tank is empty, such as after dumping tip tank fuel. Additionally, pilots will check for empty tip tanks prior to each spin by positioning the tip tank switches to ON and noting the "L TIP EMPTY" and "R TIP EMPTY" annunciator lights illuminated.
c. Tip tank dump speed will be 140 KIAS. In addition to procedures in 2b. above, visual indications of dump nearing completion is defined as a fuel "trickle" or significant slowing of tip tank fuel dump rate .

3. SPECIAL CONSIDERATIONS: A curriculum development sortie(s) shall be accomplished to evaluate the impact of this change and determine if additional planning is required prior to using this modification on student training missions.

4. RISK ASSESSMENT: This modification should lower the overall program risk by addressing the unexpected cause revealed by the mishap. The assigned risk level remains LOW for the spin mission. The curriculum development sortie is also assessed as LOW risk.

5. COORDINATION COMMENTS:

TEST PR[illegible]T SAFETY REVIEW (INITIAL AND AMENDM[illegible])
(Refer to AFFTCR 127-3 for complete instructions)

I. PROJECT INFORMATION

INITIAL PROJECT TEST TITLE	INITIAL RISK LEVEL	CONTROL NUMBER	TEST AGENCY
AF Test Pilot School Flying Qualities Phase	LOW	94-31	USAF TPS

SUBJECT OF AMENDMENT	AMENDMENT RISK LEVEL	CHANGE NUMBER	PROJECT JON
Variable Stability In-Flight Simulator Test Aircraft (VISTA) Demonstration and Training Flights	LOW	3	M94C1400

PROJECT MANAGER (Typed Name and Grade)	SIGNATURE	PHONE NUMBER	DATE
Mark S. Erickson, Major	Mark S. Erickson	277-2348	6 Mar 95

UNIT TSO (Typed Name and Grade)	SIGNATURE	PHONE NUMBER	DATE
James A. Esch, Major	James A. Esch	277-8038	6 Mar 95

II. SAFETY REVIEW MEMBERS

NAME, GRADE, AND TITLE	SIGNATURE AND DATE	NAME, GRADE, AND TITLE	SIGNATURE AND DATE
a. Robert Wilson, Maj, Operations Rep	Robert A Wilson 7 Mar 95	f.	
b. Thomas Twisdale, Civ, FQ Rep	Thomas R Twisdale 7 Mar 95	g.	
c.		h.	
d.		i.	
		j.	

III. COORDINATION AND APPROVAL

POSITION TITLE	SIGNATURE	DATE	ACTION (COORD, APPROVE, INFO, OR N/A)	COMMENTS ADDED YES	COMMENTS ADDED NO
TEST SAFETY OFFICER AFFTC/SET	David A Lazo	3-7-95	Coord	✓	
DIRECTORY OF SAFETY AFFTC/SE	Will R Stewart	3-7-95	Coord		✓
SQUADRON COMMANDER OR EQUIVALENT USAF TPS/DO	Michael Leone	3-7-95	Coord		✓
TEST WING ENGINEER OR EQUIVALENT 412 TW/TS	[illegible]	7 Mar 95	Coord		✓
GROUP COMMANDER OR EQUIVALENT USAF TPS/CC	Mark Dickinson	8 Mar 95	Approve		✓
GROUP COMMANDER OR EQUIVALENT 412 OG/CC	James M Payne	1995 MAR [illegible]	Info		✓
TEST WING COMMANDER OR EQUIVALENT 412 TW/CC	Ted M McFarland	12 Mar 95	Info		✓
C COMMANDER (OR AS DELEGATED) TC/CC	[illegible]	20 Mar [illegible]	Info	✓	[illegible]

RETURN TO AFFTC/SET

AFFTC FORM 5028 APR 93 (EF) Replaces AFFTC Forms 5028, Sep 89, and 5028b, Feb 91, which will not be used

3-046

IV. PROJECT DESCRIPTION

Instructions: Include the following sections: Background, Test Objective, Test Item Description, System Maturity, Types of Tests, Differences from Previous Tests and Scope. An amendment will incorporate changes inherent within these sections. Use additional sheets if necessary.

V. SAFETY REVIEW SUMMARY

Instructions: Include the following sections: Review and Synopsis, References, Mishap Responsibilities, General Minimizing Considerations, Special Considerations, Action Items, Risk Assessment, and Coordination Comments. An amendment will incorporate changes inherent within these sections. Use additional sheets if necessary.

SECTION IV: PROJECT DESCRIPTION:

1. BACKGROUND: Developmental flight testing of the VISTA F-16 was completed in January 1995. The full Variable Stability envelope has been cleared and the aircraft has been flown to touchdown with both level I and level II flying qualities simulations. The aircraft is due to arrive at Edwards on 6 Mar 95 for approximately four staff sorties in preparation for recurring use with TPS students beginning with class 95A.

2. TEST OBJECTIVES: The VISTA will be used to provide training in the area of advanced flight control testing and handling qualities evaluation at the USAF TPS. USAF TPS instructors will fly demonstration/ evaluation sorties to refine plans for curriculum implementation. This amendment covers staff curriculum development flights and subsequent student demonstration sorties.

3. TEST ITEM DESCRIPTION: The VISTA is a highly modified F-16D Block 30, Peace Marble II (Israeli) aircraft with Block 40 avionics and a Digital Flight Control System (DFLCS). The most significant modification to the F-16D aircraft was the installation of a Variable Stability System (VSS) that will interface with the DFLCS allowing the aircraft to fly with a variety of control laws. Other modifications to the F-16D aircraft include a front seat center stick controller in addition to the typical side stick controller, additional aft cockpit controls, a higher flow-rate hydraulic system, higher rate actuators, and modifications to the electrical and avionics systems. Necessary F-16 controls were relocated from the front to the aft cockpit to allow the pilot in command to fly from the aft cockpit.

Three basic modes of flight control are provided on the VISTA:

1) Basic F-16 host aircraft operations from the rear cockpit.
2) Basic F-16 host aircraft from the front cockpit (F-16 convenience mode and F-16 emergency mode).
3) Variable stability operations from the front cockpit.

4. SYSTEM MATURITY:
The VISTA aircraft has completed developmental testing and is ready for operational use. The Variable Stability System (VSS) gain envelope has been cleared and the aircraft has been flown to touchdown with the system engaged. Overall, the test team was satisfied with the aircraft's automatic safety features. The program has flown over 60 flights and 125 hours accomplishing over 100 landings with the system engaged. The aircraft has been flown up to 3.0 hours on a single mission. Six demonstration sorties have been flown during the program including flights with non F-16 qualified pilots and a flight test engineer. In Dec 95 three USAF TPS instructor pilots flew demonstration sorties in VISTA.

5. TYPES OF TESTS: No testing is planned during this flight phase. All flights will be flown within the VISTA F-16 approved envelope.

6. DIFFERENCES FROM PREVIOUS TESTS: The VISTA aircraft will supplement the Calspan Learjet as a platform for variable stability and flight control system design training

7. **SCOPE:**
Approximately four demonstration/eva..ation sorties will be flown by USAF TP.. .nstructors to refine plans for curriclum implementation. Curriculum development sorties are currently scheduled for 8-10 Mar 95. Student training sorties will be flown beginning late summer 1995 and recurring approximately every six months.

...CTION V: SAFETY REVIEW SUMMARY:

1. **REVIEW SYNOPSIS:** A Technical Review Board (TRB) and Safety Review Board (SRB) USAF TPS flying qualitites curriculum training was completed in Apr 94. This amendment is within the scope of the original safety planning. A safety review board reconvene was not required, however a review by non-project operational and engineering representatives was required. Adequate system safety analysis has been accomplished and no issues remain open from the analysis.

2. **REFERENCES:** In addition to those listed in the original 5028 package:

a. Test Project Safety Review, AFFTC Control Number 94-38, Variable Stability In-Flight Simulator Test Aircraft (VISTA) Flight Test Plan, as amended.

b. Test Plan for VISTA NF-16D Test Pilot School Demonstration and Training Flights, Contract No. F33615-93-C-3608, 3 Feb 95.

3. **MISHAP RESPONSIBILITIES:**

The Air Force Flight Test Center (AFFTC) has mishap investigation and reporting responsibilities IAW AFI ~~127-4.~~ AFMC has mishap accountability.
91-204

GENERAL MINIMIZING CONSIDERATIONS:

Because all testing has been completed, there are no "test unique" hazards. However, do to the unique configuration of the aircraft, the following General Minimizing Procedures will apply:

a. No gain changes will be made to the VSS configuration in-flight, except as prescribed on the test card.

b. All gains will be set within the cleared gain envelope.

c. The pilot in command will be a VISTA instructor pilot.

d. Approaches by non-rated evaluation pilots will be terminated at 50' AGL.

e. VSS BIT will be accomplished prior to take-off to verify all safety trips test good.

f. GROUND SIMULATION WILL BE CONDUCTED BEFORE FLIGHT ON ALL FCS PROJECT DESIGNS. (SEE COVER COMMENTS) M

5. **TEST ARTICLE RESTRICTIONS:** With the VSS engaged, VISTA is limited to 80% of the normal F-16 design limit load. The AOA in VSS mode is limited to 16 degrees and the maximum airspeed is 440 knots/.9M. Using F-16 control laws the maximum airspeed is 550 knots/1.2 M.

6. **SPECIAL CONSIDERATIONS:** None.

7. **ACTION ITEMS:**

RISK ASSESSMENT: This change does not alter the originally assigned risk of LOW.

AFFTC FORM 5028 (Supplemental Continuation Page) APR 93

9. COORDINATION COMMENTS:

My primary concern was flying the student projects. Paperwork does state gain will be within the cleared envelope. The test plan states the project will be ground simulated prior to flight. Should the ground simulation requirement be in the safety paperwork as a GMC? Otherwise everything looks good.

[signature]

→ Cal Span needs to do the ground simulation as a GMC, thats SOP for projects like this - and is appropriate for curriculum development.

→ This package is fine for TPS curriculum development, however I'd recommend that after the development and when Cal-Span finishes their operating limitations flight manuals that this be revised to reflect the TPS flying qualities revision and Cal-Span procedures for the various configurations. This way your updating the system maturity - in terms of how TPS plans to use the airplane - and only have to carry forward GMC/THA'S not identified by Cal-Spans documentation.

[signature]

USAF TPS/EOF RESPONSE TO COORDINATION COMMENTS —

- GROUND SIMULATION WILL BE CONDUCTED BEFORE FLIGHT ON ALL FLIGHT CONTROLS PROJECT DESIGNS. (ADDED GMC)
- USAF TPS WILL COMPLY WITH MR. LAZERSON'S RECOMMENDATION FOR A FOLLOW-ON PACKAGE FOR STUDENT DEMO FLIGHTS.

[signature]
8 MAR 95

- IS THERE A RISK (HAZARD) OF MIDAIR DUE TO RESTRICTED VISIBILITY OF IP AND PERHAPS UNQUALIFIED FRONT C/P OCCUPANT.

[signature]

To: BORTONJ (Maj ..frey Borton)
From: ENGEL@FTC
Cc: CATERINA@se,DOOLITEJ,ELLEDGEA,LLEWELYN,MNELSON,RNEVILLE
Bcc:
Subject: re: Updated Response to VISTA Coordination Comments
Attachment:
Date: 8/28/95 12:40 PM

Jeff -

Thanks, we need to have -- perhaps not in the safety package, that is up to safety -- a clear "criteria" we use to make the decision to add a chase. Otherwise, this gets too squishy and over time it fades from everyones memory and we do not use a safety chase at all.

Rich

Original text
From BORTONJ@TPS.EDW (Maj Jeffrey Borton), on 8/28/95 11:08 AM:
Gen Engel,

Sir, as we are starting to fly VISTA again these next few weeks, I wanted to respond to your question regarding the possible risk with unqualified front cockpit occupant in VISTA. Please see bullet #3 below...

USAF TPS/EDF updated response to coordination comments (8/25/95):

-TPS is planning student demonstration flights and curriculum development flights from 28 Aug - 15 Sep 95. CALSPAN has not updated the basic test plan (Feb 95) from the one used in planning this safety package. CALSPAN's next revision will carry forward items from this package.

-CALSPAN has issued a Partial Flight Manual for the aircraft and Flight Briefing Notes for the student demo flights. These documents will be added to the list of references in the Safety Review Summary.

-TPS's intent is to fly only pilots during student demo sorties in this class (95A). Future demonstration flights will take into account the fact that a non-rated crew member may occupy the front seat (evaluator position) on VISTA. In response to Gen Engel's question regarding the risk of midair collision with non-rated occupants in the front seat, TPS/EDF has consulted with both CALSPAN and Maj Bob Wilson (AF pilot on VISTA developmental program). Based on their advice, each front-seat sortie with FTEs will be evaluated on a individual basis, as the flight experience level of non-rated students varies. For such sorties, tasks involving air to air tracking, low level flight, or operations in congested airspace will be minimized.

To SET: TPS has filed this in with the VISTA test safety package (94-31, Change 3).

Thanks,

Jeff Borton

TEST HA[illegible]RD ANALYSIS (THA)

TEST SERIES VISTA/F-16	HAZARD CAT/PROBABILITY I/REMOTE
PREPARED BY (NAME AND TITLE) Mark S. Erickson, Major	SIGNATURE M S Erickson
UNIT TEST SAFETY OFFICER (TYPE NAME AND GRADE) James A. Esch, Major	SIGNATURE James A. Esch

HAZARD: Neither pilot in active control of the aircraft during a critical phase of flight.

CAUSE:
1. Poor inter cockpit communication as to which pilot is in control
2. Safety pilot delays taking control after an unexpected VSS disengage.
3. Safety pilot becomes incapacitated.

EFFECT: Loss of aircraft / death

MINIMIZING PROCEDURES:

1. (1) VSS engagement will be accompanied by the safety pilot notifying the evaluation pilot that control is in the front cockpit and the evaluation pilot acknowledging.

2. (2) The safety pilot will immediately take control if any trip is indicated such as a warning tone, flashing trip light, flashing HUD reticle.

3. (3) The evaluation pilot will be briefed on the F-16 emergency mode operation and instructed to use it when the safety pilot appears to be incapacitated.

4. (1) The VSS will not be engaged without 100 feet nose to tail separation with all aircraft in the formation.

5. (1) VSS engagement will not be accomplished below 500 feet AGL.

CORRECTIVE ACTION:
1. If either pilot is uncertain as to who has control of the aircraft, they will query the other pilot. If there is no response the pilot making the original inquiry will take control using the F-16 emergency mode if in the front seat or by disengaging the VSS if in the back seat.

REMARKS:
1. VSS disengagement is indicated by an aural tone, flashing cockpit light and flashing HUD reticle.

2. The VSS engagement sequence requires pilot action in both cockpits which alerts the evaluation pilot that control is about to be passed to the front cockpit.

3. Indicator lights in both cockpits show when the VSS is engaged or when in emergency or convenience mode.

AFFTC FORM 5028A APR 93 (EF) PREVIOUS EDITION IS OBSOLETE

TES' IAZARD ANALYSIS (THA)

HAZARD CAT/PROBABILITY
I/IMPROBABLE

TEST SERIES
VISTA/F-16

PREPARED BY (NAME AND TITLE)
Mark S. Erickson, Major

SIGNATURE
M S Erickson

UNIT TEST SAFETY OFFICER (TYPE NAME AND GRADE)
James A. Esch, Major

SIGNATURE
James A. Esch

HAZARD: Unintentional ejection from the front cockpit.

CAUSE: Lowering the front seat with the center stick full aft pulls the ejection handle.

EFFECT: Loss of aircraft / death.

MINIMIZING PROCEDURES:

1. Prior to raising or lowering the front seat the evaluation pilot will ensure the center stick is clear of the ejection handle.

CORRECTIVE ACTION: None

REMARKS:

1. When the stick is not in use mechanical stops can be used to preclude stick/D-ring contact. When the mechanical stops are not used during flight, the pilot's arm and hand may contact the D-ring before the stick does. When the stick is not in use during flight, the pilot will tend to move the stick away from the seat to give him more room in the cockpit.

2. The center stick can be removed when not required for the mission.

3. During VSS disengage the center stick centers itself clear of the ejection handle.

4. The partial flight manual contains warnings on the potential for unintentional ejection caused by the center stick.

TES' :AZARD ANALYSIS (THA)	PAGE 3 OF 5 PAGES
TEST SERIES VISTA/F-16	HAZARD CAT/PROBABILITY I/IMPROBABLE
PREPARED BY (NAME AND TITLE) Mark S. Erickson, Major	SIGNATURE MSErickson
UNIT TEST SAFETY OFFICER (TYPE NAME AND GRADE) James A. Esch, Major	SIGNATURE James A. Esch

HAZARD: Front seat crew member unable to initiate ejection without delay.

CAUSE: Center stick obstructs access to the ejection handle due to a hydraulic or computer failure.

EFFECT: Death

MINIMIZING PROCEDURES:

1. The front seat occupant will be briefed on the possibility of the center stick blocking the ejection handle and the ability to move it with approximately 20 pounds of force.

2. Prior to takeoff the center stick range of motion and force required when unpressurized will be demonstrated to each new evaluation pilot.

3. When the center stick is installed, the ejection mode selector will be set in the "AFT" position.

CORRECTIVE ACTION:

1. The evaluation pilot will disengage VSS and move center stick.

2. If unable to move center stick the safety pilot will initiate ejection.

REMARKS:

1. The center stick can be removed when not required for the mission.

2. During normal VSS disengage the center stick centers itself providing clear access to the ejection handle.

3. Failure of the center stick is not in itself a cause for ejection.

AFFTC FORM 5028A APR 93 (EF) PREVIOUS EDITION IS OBSOLETE

TEST HAZARD ANALYSIS (THA)

TEST SERIES VISTA/F-16	HAZARD CAT/PROBABILITY II/IMPROBABLE
PREPARED BY (NAME AND TITLE) Mark S. Erickson, Major	SIGNATURE M S Erickson
UNIT TEST SAFETY OFFICER (TYPE NAME AND GRADE) James A. Esch, Major	SIGNATURE James A. Esch

HAZARD: Front seat crew member striking center stick or HUD during ejection.

CAUSE: 1. Center stick in the ejection envelope
2. Removal of leg guards puts HUD in the ejection envelope

EFFECT: Severe injury

MINIMIZING PROCEDURES:

1. (1) If time permits the VSS will be disengaged prior to ejection.

2. (1,2) The front seat occupant will be briefed on the possibility of the center stick or HUD striking the pilot.

3. (1) Prior to takeoff the center stick range of motion and the force required to move the center stick, when unpressurized, will be demonstrated to the evaluation pilot.

4. (1) If full travel authority of the stick is not required for the mission, the mechanical stops will be used to limit stick travel both laterally and longitudinally.

5. (2) During missions not requiring the center stick , the leg guards will be installed in the aircraft.

CORRECTIVE ACTION: None

REMARKS:

1. Upon VSS disengagement, the center stick moves out of the ejection envelope both longitudinally and laterally at the rate of 4 inches per second. This is sufficient to move the stick out of the ejection envelope.

2. If a hydraulic failure causes the disengage, the stick will not center. Pilot force is required to center the stick. This action takes approximately 20 pounds force. Also, hard over center stick failure is not in itself cause for ejection.

3. Information from the F-16 SPO indicated the leg guards were put in the aircraft based on an engineers "feeling" that the pilot might hit his legs or feet on the HUD during an ejection under side loads. The leg guards would prevent injury to the pilot. Proper normal ejection procedures, as outlined in the F-16 flight manual, would prevent this type of injury from occurring.

4. The center stick can be removed when it is not needed for a mission.

TES' IAZARD ANALYSIS (THA)

HAZARD CAT/PROBABILITY
III/OCCASIONAL

TEST SERIES
VISTA/F-16

PREPARED BY (NAME AND TITLE)
Mark S. Erickson, Major

SIGNATURE
MSErickson

UNIT TEST SAFETY OFFICER (TYPE NAME AND GRADE)
James A. Esch, Major

SIGNATURE
James A. Esch

HAZARD: Hard or improper attitude touchdown.

CAUSE:
1. Unexpected poor flying qualities
2. Improper evaluation pilot inputs
3. Late safety pilot takeover

EFFECT: Minor aircraft damage

MINIMIZING PROCEDURES:

1. (1,2) The evaluation pilot will not attempt to salvage bad landings. If unacceptable flying qualitites exist, the evaluation pilot will command a VSS disengagement, terminating the simulation.

2. (3) The safety pilot will take over if any of the following situations exists at or below 50 ft AGL:

   a. airspeed decreasing and more than 10 knots below recommended approach speed.
   b. AOA higher than 11 degrees with no tendency to decrease.
   c. an unarrested sink rate develops.
   d. an unacceptable PIO develops in any axis.
   e. rapid pitch or roll attitude changes.
   f. either pilot's comfort level is exceeded for any reason.

CORRECTIVE ACTION:
1. Abort on the runway or initiate immediate go around.

2. If still airborne, confirm aircraft structure with a chase aircraft if available and perform a controllability check.

REMARKS:
1. Current VSS aircraft have been flown safely to touchdown with VSS engaged.

2. All safety pilots are highly experienced in-flight simulator pilots.

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TEST [illegible]JECT SAFETY REVIEW (INITIAL AND AMENDM[illegible])

(Refer to AFFTCR 127-3 for complete instructions)

I. PROJECT INFORMATION

IN[illegible]AL PROJECT TEST TITLE	INITIAL RISK LEVEL	CONTROL NUMBER	TEST AGENCY
[illegible] Test Pilot School Flying Qualities Phase	LOW	94-31	USAF TPS

SUBJECT OF AMENDMENT	AMENDMENT RISK LEVEL	CHANGE NUMBER	PROJECT JON
T-2 Spin Program	LOW	4	M94C1400

PROJECT MANAGER (Typed Name and Grade)	SIGNATURE	PHONE NUMBER	DATE
Alan J. Borton, Maj	Alan J Borton	x72348	23 Aug 95

UNIT TSO (Typed Name and Grade)	SIGNATURE	PHONE NUMBER	DATE
David A. Lazerson, Civ	David A. Lazerson	x74565	23 Aug 95

II. SAFETY REVIEW MEMBERS

	NAME, GRADE, AND TITLE	SIGNATURE AND DATE		NAME, GRADE, AND TITLE	SIGNATURE AND DATE
a.	D.G. Carey, Maj SRB Chairman	D. Wayne Carey 30 Aug 95	f.		
b.	Robert Wilson, Maj Ops Representative	Robert A Wilson 30 Aug 95	g.		
c.	Fred Webster, Civ Technical Representative	Fred Webster 31 Aug 95	h.		
d.	Edward Kolano USN TPS Representative	E Kolano 8-24-95	i.		
[illegible]			j.		

III. COORDINATION AND APPROVAL

POSITION TITLE	SIGNATURE	DATE	ACTION (COORD, APPROVE, INFO, OR N/A)	COMMENTS ADDED YES	COMMENTS ADDED NO
TEST SAFETY OFFICER AFFTC/SET	Abigail L. Kenter FOR MAJ CAREY	8/31/95	Coord	✓	
DIRECTOR OF SAFETY AFFTC/SE	Will R Stewart	9/1/95	Coord	✓	
SQUADRON COMMANDER OR EQUIVALENT USAF TPS/DO	Randall L Neville	9/1/95	Coord		✓
TEST WING ENGINEERING OR EQUIVALENT 412 TW/TS	[signature]	5 Sept 95	Coord		✓
GROUP COMMANDER OR EQUIVALENT USAF TPS/CC	[signature]	6 SEP 95	Approve		✓
GROUP COMMANDER OR EQUIVALENT 412 OG/CC	James M Payne	1995 SEP 07	Info		✓
TEST WING COMMANDER OR EQUIVALENT 412 TW/CC	[signature]		Info		✓
[illegible]OMMANDER (OR AS DELEGATED) A[illegible]TC/CC For	[signature]	12 SEP	Info		✓

RETURN TO AFFTC/SET

AFFTC FORM 5028 APR 93 (EF) Replaces AFFTC Forms 5028, Sep 89, and 5028b, Feb 91, which will not be used

9-038

IV. PROJECT DESCRIPTION

INSTRUCTIONS: Include the following sections: Background, Test Objectives, Test Item Description, System Maturity, Types of Tests, Differences from Previous Tests and Scope. An amendment will incorporate changes inherent within these sections. Use additional sheets if necessary,

V. SAFETY REVIEW SUMMARY

INSTRUCTIONS: Include the following sections: Review Synopsis, References, Mishap Responsibilities, General Minimizing Considerations, Special Considerations, Action Items, Risk Assessment, and Coordination Comments. An amendment will incorporate changes inherent within these sections. Use additional sheets if necessary.

SECTION IV: PROJECT DESCRIPTION

1. **BACKGROUND:** The USAF TPS requires spin test training to meet its course training standards for all graduates. Previously, the A-37s at the AFFTC provided this training. Since the last A-37 has been excessed, TPS has entered into an agreement with the United States Naval Test Pilot School (USN TPS) to utilize their T-2C aircraft for the spin portion of their curriculum. As part of this agreement, the Navy has modified two of their T-2C aircraft with a new instrumentation and data recording system. The two test pilot schools have shared for the cost of this modification. Beginning in Sep 95, the USAF TPS will require the T-2s in March and September of each year for 2-3 weeks per class. USN TPS instructor pilots will deploy with the aircraft and be in command on all flights.

2. **TEST OBJECTIVES:** The general training objectives remain the same as with the A-37, as the T-2C is the current spin test trainer for the USN TPS. Like the A-37, the T-2 will allow the students to apply techniques previously learned in the classroom and in the glider spin demos. The new instrumentation system and telemetry capability will greatly enhance the total training value at both schools. This amendment will cover all remaining curriculum development flights and flights planned with USAF TPS students while the T-2s are deployed at Edwards (including T-38 spin chase sorties).

3. **TEST ITEM DESCRIPTION:** The T-2C is a tandem, two-place subsonic trainer used extensively by the USN and USN TPS. With a max takeoff weight of approximately 14,000 lbs, it is powered by two J-85-GE-4 engines, and has dual power sources for electrics, hydraulics, and air conditioning systems. The flight control system includes hydraulic full-powered ailerons, a boosted elevator, a yaw damper, and an electrical trim system. Fuel is carried in the fuselage, wings and nonjettisonable wing tip tanks. The ejection seats are rated from ground level/75 KIAS to the aircraft speed /altitude limit (485 KIAS/0.85 Mach and approximately 40,000 ft).

The T-2Cs flown by USAF TPS will be modified with a Small Pulse Code Modulation (SPCM) Advanced Airborne Test Instrumentation System (AATIS). Included in this package are data recording and telemetry capabilities, as well as a test boom for altitude, airspeed, angle of attack and sideslip. These modified T-2Cs are considered production representative.

The T-2's performance and fuel capacity is adequate to accomplish at least eight spins per sortie. It weights about 5000 lbs more th the A-37 but can easily climb up to altitude and is pressurized for pilot comfort. Dumping tip tank fuel is a mechanical operation and h no history of failures at USN TPS (tip tanks can be verified dry with a visual sight gauge). Compared to the A-37, the T-2 spins slightly steeper and slower. Post-stall gyrations are more dynamic and take slightly longer to stabilize, though in general the T-2C is more susceptible to departure . All recoveries taught previously in the A-37, including the hands off, can recover the T-2 from an erect spin.

4. **SYSTEM MATURITY:** As mentioned above, the T-2Cs have been used for over 20 years as the Navy's primary jet spin training aircraft. The T-2 spin program at USN TPS includes both demonstration and data flights, with students allowed to spin "crew solo" for the data flights. Navy TPS does not currently use a spin chase, though telemetry is desired for curriculum sorties. The new instrumentation package installed in the T-2Cs has not changed its basic spin characteristics and several functional check flights will be accomplished prior to deployment to Edwards. USAF TPS instructors have previously evaluated the T-2C as a replacement for the A-37s (Sep 93) and have chased it with the T-38 during spin sorties at Pax River (Apr 95), and found it suitable in both cases.

The modified T-2Cs were chosen specifically due to the forecast of minimal maintenance requirements on those tail numbers. The Navy will perform an NDI on the aircraft prior to each deployment. The enhanced preflight/postflight inspection accomplished on each spin sortie at Pax River will also be completed at Edwards. The USN TPS expects to be using the T-2 for spins for the foreseeable future.

5. **TYPES OF TRAINING:** All flights will be within the approved envelope for the aircraft. Though inverted spins are a prohibited maneuver, USN TPS operates under a waiver which will also apply to the spins with the USAF TPS.

6. **DIFFERENCES FROM PREVIOUS TESTS:** The spin profiles for the USAF TPS will be identical to those flown at USN TPS with the exception that USAF students will always fly with a Navy instructor. All aircraft ops (pre/post spin checklists, safety procedures and maintenance inspections) will be in accordance with current Navy and USN TPS directives. Minor profile modifications may be made for operating in R-2508. Spin chase using a T-38 is desired for all spin sorties (SPORT or TM providing backup altitude calls if no chase).

IV. **PROJECT DESCRIPTION**

INSTRUCTIONS: Include the following sections: Backgrou..d, Test Objectives, Test Item Description, System Maturity; Ty..s of Tests, Differences from Previous Tests and Scope. An amendment will incorporate changes inherent within these sections. Use additional sheets if necessary,

V. **SAFETY REVIEW SUMMARY**

INSTRUCTIONS: Include the following sections: Review Synopsis, References, Mishap Responsibilities, General Minimizing Considerations, Special Considerations, Action Items, ...essment, and Coordination Comments. An amendment will incorporate changes inherent within these sections. Use additional sheets if necessary.

7. **SCOPE:** Each pilot will receive two spin sorties, while each FTE/N will receive one sortie. As with the A-37 spin program, each student will receive a spin chase demonstration sortie in the T-38, with qualified pilots being allowed to chase subsequent spin sorties "crew solo." Instrumentation checkout sorties are planned the week of 4 Sep 95. Student flights are scheduled from 11-26 Sep 95, and recurring approximately the same period in March/September for subsequent classes.

SECTION V: SAFETY REVIEW SUMMARY

1. **REVIEW SYNOPSIS:**

Technical: No changes to the test objectives of the Flying Qualities Phase Planning Guide are planned. Though a different spin platform, use of the T-2C does not change the technical content of the spin demonstration and data sorties. Extensive coordination has been accomplished with USN TPS to ensure USAF students will receive comparable training to that in the A-37. No TRB is required.

Safety: This amendment is within the scope of the original safety planning. However, due to the higher risk of spin training when compared to other curriculum flights, a formal Safety Review Board was convened on 23 Aug 95 in the safety conference room.

2. **REFERENCES** (In addition to those listed in the original 5028 package):

a. T-2B/C NATOPS Flight Manual, Current version
b. USN TPS Safety Checklist (used by USN TPS as a guide in safety planning for student "crew solo" spin data sorties)
c. Waiver Letter from Commander, NAVAIRSYSCOM, 26 Apr 72 (authorizes inverted spins in T-2Cs assigned to USN TPS)
d. "Contractor's Aerodynamic Demonstration (Inverted Spins) of the T-2B Airplane," NATC Report FT-91R-65, 15 Dec 65
e. "Demonstration Data Report for the Model T-2B Airplane," Report Number NA65H-676, North American Aviation, 31 Jan 66
f. "Evaluation of Spin Characteristics of the T-2B Airplane," NATC Report FT-73R-67, 28 Nov 67

...ISHAP RESPONSIBILITIES:

As the USN TPS will maintain possession and responsibility for the T-2C aircraft, the Naval Test Center at Patuxent River, Maryland will have mishap accountability, as well as investigation and reporting responsibility. The AFFTC will provide initial response to any mishap and assist in the investigation.

4. **GENERAL MINIMIZING PROCEDURES:**

The following General Minimizing Procedures will apply to T-2C spin missions:

a. Phase B, C, D stalls and spins will be accomplished in a designated spin area.
b. All flights will be conducted within the permissible NATOPS T-2C envelope, expanded by written waiver to include intentional inverted spins.
c. A T-2C qualified instructor test pilot will be in command on all sorties.
d. An enhanced maintenance preflight/postflight will be accomplished for all spin sorties.
e. No more than 4 sustained negative g maneuvers may be performed on any flight due to venting from the engine oil system.
f. Spin recovery controls will be applied by 20,000 ft MSL.

5. **SPECIAL CONSIDERATIONS:** None.

6. **ACTION ITEMS:**

1) Obtain copies of spin testing completed on T-2 as reference for USAF TPS. *(Closed--Pax River will send copies to USAF TPS).*
2) Determine if asymmetric fuel load in tip tanks is a cause for failure to recover from intentional departure or spin. *(Closed--See THA #2. Previous departure/spin testing has not been accomplished for asymmetric loading. However, it is the Navy's experience that no spin-related mishaps have occurred at Pax River in the T-2 due to asymmetric loading. The NATOPS spin recovery procedure has always ... successful.).*

...SK ASSESSMENT: This does not alter the original assigned risk assessment of LOW.

8. **COORDINATION COMMENTS:**

8. COORDINATION COMMENTS: (CONT.)

Please add this to the current list of General Minimizing Procedures: ✓ (31 Aug 95)
f. Spin recovery controls will be applied by 20,000 ft MSL.

D.G. Carey, MAJ, USAF
AFFTC/SET

Has the Navy asked NAVAIRSYSCOM about the effects of a lifetime of spinning (including inverted spins) on their airframes? What inspections are done on these T-2s above and beyond the inspections done for general fleet T-2s? ✓ (5 Sep 95, see next pg)

Another consideration involves the planned out of control ejection altitude of 7,000' AGL. Will this be sufficient for a safe dive recovery by a T-38 safety chase aircraft? The chase aircraft could conceivably be in a very nose-low, steeply banked attitude when passing this altitude. ✓ (5 Sep 95, see next pg)

Will R. Stewart

WILL R. STEWART, COL, USAF
Chief of Safety

AFFTC FORM 5028 (Supplemental Continuation Page) APR 93

To: STEWART.SE
From: BORTONJ (Maj J. frey Borton)
Cc: ELLEDGE.TPS,CAREY.SE,LLEWELYN.TPS
Bcc:
Subject: SE Comments re: T-2 Spins at TPS
Attachment:
Date: 9/5/95 9:02 AM

Col Stewart,

Based on our phone conversation, I will insert this response to your questions into our safety package:

1. Effect of lifetime of spinning on T-2 airframes: From discussions with Navy TPS, there have been no defects found during recurring visual inspections and NDI of the aircraft. In 1977, the horizontal stabilizers on all T-2s (including those at PAX) were strengthened with a "doubler." In addition, the flight manual restricts rudder inputs above 160 KIAS to reduce loads on the tail. TPS will continue to research and update this package with any data the Navy might have on the cumulative effects of spins.

2. Inspections completed on PAX T-2s above and beyond general fleet: As mentioned in the System Maturity, the Navy performs NDI after 90 total spins with high loads on the tail (virtually every spin sortie at TPS qualifies for this). Each T-2 will have an NDI performed immediately prior to each deployment to Edwards. Additional preflight/postflight inspections (primarily on fuel systems and visual) are completed for those sorties performing negative g maneuvers/inverted spins (again, virtually every spin sortie at TPS). Once more, any additional information TPS learns from research will be included in this package.

3. Dive recovery for chase aircraft from 7000 ft AGL: Based on previous experience, chasing a spin should not involve descents below about 14,000 ft MSL. However, it will be emphasized to students and IPs that chasing the aircraft down to bailout altitude of 7000 ft AGL may involve additional risk (but should not prohibit dive recovery), especially if the chase is coming in from a steep dive.

Thanks,

Jeff Borton

TEST HAZARD ANALYSIS (THA)	PAGE 1 OF 2 PAGES
TEST SERIES USAF TPS Flying Qualities Phase (T-2 Spin Program)	HAZARD CAT/PROBABILITY II/Remote
PREPARED BY (TYPE NAME AND TITLE) Alan J. Borton, Maj	SIGNATURE Alan J Borton
UNIT TEST SAFETY OFFICER (TYPE NAME AND GRADE) Dave Lazerson, Civ	SIGNATURE David A. Lazerson

HAZARD: Engine Compressor Stall/Flameout During Intentional Stalls, Departures, or Spins

CAUSE: 1. Engine Malfunction
2. Improper Throttle Technique

EFFECT: Damage to Engine(s), Major Aircraft Damage

MINIMIZING PROCEDURES:

1. (1,2) IP will monitor engines during stalls and spins.
2. (2) Throttle will be set to IDLE for all Phase B, C, D stalls and spins.
3. (1) Engine anti-ice will be ON to bleed compressor pressure per pre-spin checklist.
4. (2) The PCL (throttle) idle stop will be engaged and throttle friction set prior to Phase B, C, D stalls and spins per pre-spin checklist.

CORRECTIVE ACTION:

1. For loss of one engine, crew will perform single engine return to a precautionary landing pattern.
2. For loss of both engines, all restarts will be IAW the T-2C NATOPS Flight Manual.

REMARKS:

1. There is no history of T-2C compressor stalls/flameouts associated with high-AOA maneuvers at USN TPS.
2. A single or dual engine flameout (actual or inadvertent) during the mission will be cause for mission termination.

TEST HAZARD ANALYSIS (THA)

TEST SERIES
USAF TPS Flying Qualities Phase (T-2 Spin Program)

HAZARD CAT/PROBABILITY
I/Improbable

PREPARED BY (TYPE NAME AND TITLE)
Alan J. Borton, Maj

SIGNATURE
Alan J. Borton

SAFETY OFFICER (TYPE NAME AND GRADE)
[illegible] Lazerson, Civ

SIGNATURE
David L. Lazerson

HAZARD: Failure to Recover from Intentional Departure or Spin

CAUSE: 1. Improper Pilot Procedure
2. Asymmetric Tip Tank Fuel

EFFECT: Loss of Aircrew and/or Aircraft

MINIMIZING PROCEDURES:

1. (1) All spin training will be conducted with a qualified instructor on board.
2. (1,2) The pre-spin checklist will be accomplished prior to all Phase B, C, D stalls and all spins.
3. (1) A recovery technique other than the NATOPS Flight Manual will be held for two turns maximum.
5. (1,2) The tip tanks will be verified empty prior to the Phase B, C, D stalls and spins per the pre-spin checklist.
6. (2) Tip transfer will remain selected to prevent reverse transfer into the tip tanks.

CORRECTIVE ACTION:

1. If the aircraft is not recovered by 18,000 ft MSL (15,000 ft AGL), the instructor will take control and perform a NATOPS recovery.
2. In accordance with NATOPS, ejection will be at 10,000 ft MSL (7,000 ft AGL) if no sign of recovery from the spin.

REMARKS:

1. Tip tanks can be verified dry by visually inspecting the sight gauges and the depleted flow from the dump valve while dumping.
2. Dumping tip tank fuel is a mechanical operation and has no history of failures at USN TPS.
3. Reverse transfer (into a once-empty tip tank) has occurred at USN TPS, but the estimated 100 gal in one tank did not noticeably affect the spin or the recovery - the asymmetric load was discovered while dumping the tips during RTB.

C-3160

TEST PROJECT SAFETY REVIEW (INITIAL AND AMENDMENT)

(Refer to AFFTCR 127-3 for complete instructions)

I. PROJECT INFORMATION

INITIAL PROJECT TEST TITLE	RISK LEVEL	CONTROL NUMBER	TEST AGENCY
USAF Test Pilot School Flying Qualities Phase	LOW	94-31	USAF TPS
SUBJECT OF AMENDMENT	**AMENDMENT RISK LEVEL**	**CHANGE NUMBER**	**PROJECT JON**
Deletion of GMC for F-16 Departure Sortie	LOW	5	

PROJECT MANAGER (Typed Name and Grade)	SIGNATURE	PHONE NUMBER	DATE
Alan J. Borton, Major	Alan J Borton	72348	18 Jan 96
UNIT TSO (Typed Name and Grade)	**SIGNATURE**	**PHONE NUMBER**	**DATE**
David A. Lazerson, DAF, GM-13	David A. Lazerson	74565	1-11-96

II. SAFETY REVIEW MEMBERS

NAME, GRADE, AND TITLE	SIGNATURE AND DATE	NAME, GRADE, AND TITLE	SIGNATURE AND DATE
a. D. G. Carey, Maj, F-16 Deep Stall Instructor, Operstions Rep	Duane Carey 22 JAN 96	a. Dan Levin, Maj, F-16 ~~Deep Stall Instructor, TPS~~ Chief F-16 Pilot, TPS	Daniel Levin 1-11-96
b. Doyle Janzen, GS-12, F-16 High AOA, Engineering Rep	Doyle B. Janzen 23 JAN 96	b. Robert Malacrida, Maj, ~~Chief F-16 Pilot, TPS~~ Deep Stall Instructor, TPS	Robert Malacrida 10 Jan 96
c.		h.	
d.		i.	

III. COORDINATION AND APPROVAL

POSITION TITLE	SIGNATURE	DATE	ACTION (COORD, APPROVE, INFO, OR N/A)	COMMENTS ADDED YES	COMMENTS ADDED NO
TEST SAFETY OFFICER AFFTC/SET	Duane Carey	23 JAN 96	Coord	✓	
DIRECTORY OF SAFETY AFFTC/SE	Will R Stewart	23 Jan 96	Coord		✓
SQUADRON COMMANDER OR EQUIVALENT USAF TPS/DO	Randall L Neville	31 Jan 96	Coord		✓
TEST WING ENGINEER OR EQUIVALENT 412 TS/TS	Roger [illegible]	29 Feb 96	Coord		✓
GROUP COMMANDER OR EQUIVALENT USAF TPS/CC	[illegible]	8 FEB 96	Approve		✓
GROUP COMMANDER OR EQUIVALENT FOR 412 OG/CC	James M Payne	1996 MAR 05	Info		✓
TEST WING COMMANDER OR EQUIVALENT 412 TW/CC	T. McFadden	7 Mar 96	Info		✓
AFFTC COMMANDER (OR AS DELEGATED) AFFTC/CC	[illegible]	11 Mar 96	Info		✓

RETURN TO AFFTC/SET

AFFTC FORM 5028 APR 93 (EF) Replaces AFFTC Forms 5028, Sep 89, and 5028b, Feb 91, which will not be used

3-020

IV. PROJECT DESCRIPTION

Instructions: Include the following sections: Background, Test Objective, Test Item Description, System Maturity, Types of Tests, Differences from Previous Tests and Scope. An amendment will incorporate changes inherent within these sections. Use additional sheets if necessary.

V. SAFETY REVIEW SUMMARY

ctions: Include the following sections: Review and Synopsis, References, Mishap Responsibilities, General Minimizing Considerations, Special Considerations, Action s, Risk Assessment, and Coordination Comments. An amendment will incorporate changes inherent within these sections. Use additional sheets if necessary.

SECTION IV: PROJECT DESCRIPTION:

1. **Background:** The USAF Test Pilot School Flying Qualities curriculum includes high angle of attack training. This training is implemented with the Flying Qualities Phase Planning Guide (PPG). High angle of attack training includes: Near Stall/Stall Demonstration, Glider Spin, Spin Demonstration, and F-16 Departure sorties. Details can be found in the PPG section IV. Review of the PPG was accomplished by TPS in March of 1994. Both the PPG and associated safety planning were reviewed in May of 1994. During that review the previous safety planning for the F-16 departure sortie was brought forward and all planning from previous amendments incorporated into the new planning. One such item was the following GMC: "MPO assisted entries will not be performed in Block 15 aircraft with the modified yaw rate limiter (TCTO 1880)". This GMC is overly restrictive and limits training. **TPS requests this GMC be deleted.**

Big tail

Mr. Doyle Janzen (F-16 FLTS) has provided the following background/system maturity to support our request:

2. **System Maturity:** The modified yaw rate limiter has an increased yaw rate time lag constant of four seconds (original was 0.25 seconds) and a doubled yaw rate to flaperon gain. Changing the time lag constant reduces the flight control reaction to higher frequency yaw oscillations. This results in more pitch rocking authority because the differential horizontal tails are not reacting as much with yaw rate. Increasing the yaw rate to flaperon gain causes the flaperons to cancel more of the yaw rate, and decreases the amount of differential horizontal tail deflection needed. This also improves pitch rocking authority. These modifications also improved the yaw and roll oscillation phase relationship during deep stalls. The yaw and roll phasing determines the rtial coupling that had become unsatisfactory with the Block 30 big inlet aircraft and the original yaw rate miter.

analog digital

The modified yaw rate limiter was evaluated on Blocks 10, 25, and 40 aircraft and was found satisfactory for all Blocks. Steady yaw rates to the right, as high as 30 degrees per second, and oscillatory yaw rates with a period of 16 seconds and magnitudes up to 50 degrees per second were observed. These yaw rates were greater than any previously experienced with the original yaw rate limiter. An increase in yaw rate was anticipated based on the flight control modifications. However, yaw rates up to 50 degrees per second were larger than anticipated. These yaw rates were not disorienting, and were much less significant than the unsatisfactory post-stall gyrations exhibited by the original yaw rate limiter in the Block 30 big inlet aircraft. In addition, the modified yaw rate limiter increased the tendency for the aircraft to self-recover from departures.

After the modified yaw rate limited small tail tests were complete, sustained yaw rates of 30 - 50 degrees per second were encountered with Block 10 aircraft flying high AOA familiarization sorties with ANG pilots. These sustained yaw rates only occurred during the "MPO-assist" portion of the maneuvers, and lasted up to two turns. It was never fully understood why the sustained yaw rates only surfaced when the MPO switch was engaged. A possible cause is the increased nose-down command when the MPO switch is engaged with full forward stick. This will not move the horizontal tails because the yaw rate limiter already commands them to the trailing edge down stops. However, the differential tail command from yaw rate has to overcome a larger nose-down pitch command when forward stick is held with the MPO engaged. This may result in slightly less differential tail when the pilot is MPO-assisting a deep stall. As a result of these sustained yaw rates, MPO-assisting deep stalls with Block 10 aircraft was discontinued.

city?

System Maturity (continued):
The subject GMC does not and should not have applied to Block 15 aircraft. There is no evidence that performing MPO-assisted deep stalls with Block 15 aircraft will produce these sustained yaw rates. Even though the modified yaw rate limiter was not specifically evaluated on a Block 15 aircraft, there is much experience with this combination. Part of the F-16 Air Defense Fighter high AOA test was conducted with F-16 75-0751, which was a production Block 10 airframe upgraded to Block 15 with the increased area horizontal tail. true

This test included many departures and some MPO-assist maneuvers with AIM-7 loadings. The Block 25 modified yaw rate limiter evaluation was conducted with F-16 80-550, which was a production Block 15 upgraded to Block 25 with the dorsal fairing. This aircraft was equivalent to a Block 15 for departure recovery and in fact, was a Block 15 aircraft in terms of mass properties. Other high AOA programs such as Block 25 AMRAAM and Block 25 LANTIRN evaluations were also conducted with F-16 80-550. There were a great number of departures and MPO-assisted deep stalls performed with many air-to-air loadings. Sustained yaw rates similar to the high AOA familiarization sorties were not observed during any of these programs. Therefore the removal of this GMC for Block 15 aircraft is prudent.

3. **Types of Tests**: No change from the original - F-16 departure sortie.

4. **Difference from Previous Tests:** Deletion of the GMC will allow MPO assisted entries into deep stall with block 15 aircraft.

SECTION V: SAFETY REVIEW SUMMARY:

1. **Review Synopsis:**

TRB: The original PPG and associated test plans were reviewed and approved in April of 1994. The test plans and PPG were found to be technically adequate. There are no test plan changes required from this amendment and consequently a reconvene of a TRB not required. The technical merit of deleting the GMC has been discussed between TPS staff and the F-16 FLTS. Both concur that deletion of the GMC does not alter the technical content of the associated test plans and PPG.

SRB: The original SRB was accomplished in May of 1994. There have been four amendments to this package since then. None of the previous amendments have any impact on the current amendment. This amendment was determined to be within the scope and intent of the original safety planning. A reconvene of the SRB was not required, however review by engineering and operations representatives was accomplished and signatures are shown in the SRB member section.

2. **General Minimizing Procedures:** From the original package delete GMC e(1)(j) "MPO assisted entries will not be performed in Block 15 aircraft with the modified yaw rate limit (TCTO 1880). All others remain as shown in the original and subsequent amendments.

3. **Risk assessment:** This amendment does not alter the original risk of LOW.

COMMENTS FROM AFFTC/SET:

1. It may be of interest to future safety planning to document the reason the GMC was originally implemented. The following paragraph is from safety package 90-60, amendment 10. **This comment needs no response from the project, it merely documents previous safety planning.**

"BACKGROUND: The F-16 general support fleet was recently modified with TCTO 1880, modified YAW Rate Limited (YRL). Unfortunately, an undesirable low-rate "spin" mode has been rediscovered with this YRL on Block 10 aircraft when in a Deep Stall. The impact of this YRL on Block 15 aircraft in a Deep Stall is minimal. Therefore, the TPS will continue the Deep Stall student sorties using Block 15 aircraft, in either the clean or centerline tank configuration. The addition of the centerline tank will allow for more Aft C.G. conditions than the clean configuration providing more effective training (TPS student sorties are currently restricted to the clean only configuration). Also, MPO assist procedures to aid the aircraft in achieving a Deep Stall condition will not be used in any Block 10 or Block 15 aircraft with the modified YRL to avoid the "spin" mode. The improved Deep Stall recoverability that the modified YRL provides in addition to the requirement that all TPS student Deep Stall sorties have a high AOA IP in the aircraft ensures an adequate safety margin."

MAJ Carey
AFFTC/SET